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ABSTRACT

The materials in this teacher's guide have three general divisions that are based on a sequential progression from kindergarten through grade six. Section A (kindergarten through two) explores the world of the child and divides this world into identifiable study groups. Section B (third and fourth grades) deals with the needs of living things and relates them to those of natural resources. Section C (fifth and sixth grades) offers material that will help children become aware of specific information about the interrelationships that exist among natural resources. Career information is included in each section. Each section is subdivided into nine topics (our world, needs, soil, plants, wildlife, water, air, land space, and minerals) which are broken down into goals, suggested activities, worksheets, teacher's notes, and an evaluation. Included are three appendixes: lists of reference books for early elementary children, middle elementary school children, and for elementary school teachers. (Author/BP)

Natural Resources
and
Career Awareness

A Teacher's Guide For Grades K-6

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Titles of all curriculum materials resulting from the project, "Career Education in the Natural Resources," grant No. OEG-0-71-4432 (357) are listed below.

Natural Resources and Career Awareness
A Teacher's Guide for Grades K-6

Exploring Occupations in the Natural Resources
A Student Resource Guide for the Middle School

Occupational Preparation in the Natural Resources
A Suggested High School Curriculum Guide

Natural Resources Technologies
A Suggested Post High School Program Development Guide

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NATURAL RESOURCES
AND
CAREER AWARENESS

A Teacher's Guide For Grades K-6

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FOREWORD

Career education is a comprehensive, systematic, and cohesive plan of instruction that provides each student the opportunity to plan and prepare for a meaningful and satisfying role as a working member of society. Occupational clusters, representative of the entire world of work and around which a career education system can be designed, were identified by the U.S. Office of Education. The 15 occupational clusters are:

business and office
marketing and distribution
communications and media
construction
manufacturing
transportation
agribusiness and natural
resources
consumer and homemaking-related
environmental control
public services
health
hospitality and recreation
personal service
fine arts and humanities
marine science

This teacher's guide is one of four publications developed by the Department of Agricultural Education, College of Agriculture, The Pennsylvania State University, as a result of a project entitled "Career Education in the Natural Resources." The project was funded under a grant from the Division of Vocational and Technical Education, Office of Education, U.S. Department of Health, Education, and Welfare.

This project grew out of a need for materials offering strategies for implementing career development programs in the field of natural resources, a part of one occupational cluster area. Although there was an abundance of information concerning vocational development theories, there was an apparent shortage of materials offering strategies for implementing these theories into operational programs. This void was causing considerable frustration to practitioners who were attempting to design and implement plans for career education.

The purposes of the overall project were: (1) to develop appropriate curriculum guides in the natural resources suggesting a sequentially-developed education program offering career awareness, career exploration, and job preparation, (2) to acquaint educational leadership in all states with the curriculum materials resulting from this project and promote their use, and (3) to disseminate in the states, copies of the curriculum materials produced in the project.

Regional Workshops were held during May and June, 1973 in nine of the Regional Offices of the U.S. Office of Education in the following cities: Boston, Philadelphia, Atlanta, Chicago, Dallas, Kansas City, Denver, San Francisco, and Seattle. These meetings were attended by more than 300 classroom teachers, guidance counselors, school administrators, teacher educators, and state education department personnel, who were acquainted with the outcomes of the project, reviewed the guide, and were instructed in its effective use and implementation in a local program. Participants made recommendations for improving the guide and for the purpose of meeting the wide variations in needs and practices across the country. These recommendations are reflected in this final document.

Career awareness at the elementary school level is generally an interdisciplinary effort to inform children in an organized manner about the world of work (Figure 1). The material in this guide is designed to aid children in developing an awareness of the importance of natural resources and some of the occupations that exist in the natural resources field.

Other curriculum materials resulting from this project are:

Exploring Occupations in the Natural Resources
A Student Resource Guide for the Middle School

Occupational Preparation in the Natural Resources
A Suggested High School Curriculum Guide

Natural Resources Technologies
A Suggested Post High School Program Development Guide

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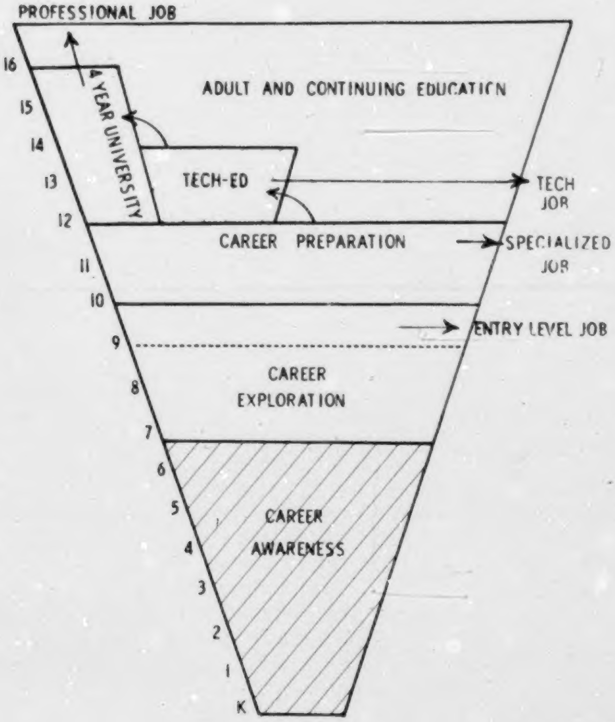
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TECH JOB
CAREER PREPARATION
SPECIALIZED JOB
ENTRY LEVEL JOB
CAREER EXPLORATION
CAREER AWARENESS

Figure 1 – Career Education. From U.S. Department of Health, Education, and Welfare, Office of Education. *Career Education: A Model for Implementation*, Draft April 1971.

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INTRODUCTION AND USE OF THE GUIDE

This guide has a twofold purpose: (1) to offer teachers a sequenced program of suggested topics and learning activities in the natural resources and (2) to offer information regarding careers in the natural resources.

GENERAL ORGANIZATION AND PROGRESSION

The material in this guide has three general divisions that are based on a sequential progression from kindergarten through grade six. Section A (grades K-1-2) explores the world of the child and divides this world into identifiable study groups. Section B (grades 3-4) deals with the needs of living things and relates them to the use of natural resources. Section C (grades 5-6) offers material that will help children become aware of specific information about and interrelationships that exist among natural resources. Career information is included in each section.

Each section is subdivided into topics, and each topic is broken down into teacher information and suggested activities. The pattern within each section is to go from general to specific and to progress in difficulty from beginning to end. This same pattern exists in going from Section A through Section C.

TOPIC ORGANIZATION

Topics include: Goals, Activities, Worksheets, Teacher's Notes, and an Evaluation.

Goals: Each topic starts with a goal statement. These statements are designed to give the teacher an idea of what the information and activities contained in the topic may do for the child.

Activities: Suggested activities for each topic are designed to be adaptable to almost any classroom situation. Teachers are encouraged to use the initial suggestions as a guide and to make any change necessary to meet particular needs.

Worksheets: Many activities involve the use of worksheets. These worksheets may be used either as masters for overhead transparencies or as sheets to be filled out or acted upon by the students. Where necessary, particular worksheet instructions are included in the text.

Teacher's Notes: Teacher's notes are inserted wherever the author felt that additional clarification, explanation, or rationale was necessary.

Evaluation: Each topic ends with suggestions for determining whether or not a child attained the goals stated at the beginning of the topic. These suggestions are written in behavioral terms but are very general. Teachers are encouraged to develop their own criteria in all performance objectives.

USE OF THE GUIDE

Order and sequence are necessary in the organization of any guide of this nature. However, teachers are encouraged to develop their own sequence of learning events by finding out where their class is regarding natural resource education and then choosing the appropriate series of topics and activities that will meet their needs. For example, a fifth- or sixth-grade teacher who wants to develop a natural resources unit with a class of children who have had little or no natural resources background may find it appropriate to use selected activities from Sections A and B to give the children the necessary background information.

The continuum that exists in the guide is intended as a suggested way to teach natural resources and career awareness to the child who starts in kindergarten and follows the program through to the sixth grade. This, however, will seldom be the case. Each topic, therefore, is designed not only to be a part of a logical progression, but also to stand alone and be used as a component in the development of individual teaching units that will meet individual needs.

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Section A OUR WORLD Topic I

GOALS: After this lesson children should:

Be aware of the fact that their world is what they hear, smell, touch, see, and taste, and use as many of these senses as are appropriate when exploring the world around them.

Be able to recognize shapes that make up their world.

Show evidence that they value sharing ideas and information and being clear and accurate in their visual and language arts activities.

TEACHER'S NOTE: Encourage the children to start their exploration with the immediate things that surround them, i.e. their desks, classroom, school building. Go on from there to the world outside of the school. The activities will be based on the multi-sensory discovery of similarities and differences.

ACTIVITY 1: Using the Senses to Discover Shapes

Put 4 or 5 items with different shapes into an old sock (sample items: a marble, a pencil, a small block, a large nut). Pass the sock around and let each child try to identify the shapes/items in the sock. See figure A-1.

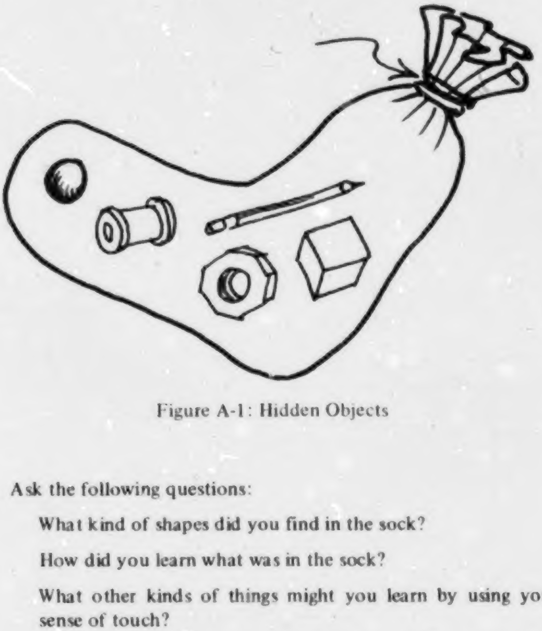


Figure A-1: Hidden Objects

Ask the following questions:

What kind of shapes did you find in the sock?

How did you learn what was in the sock?

What other kinds of things might you learn by using your sense of touch?

ACTIVITY 2: Learning With the Ears, Nose, Hands, and Eyes

Let the children explore their classroom and ask them to be ready to tell the rest of the class about something that each of them found. (This may take place over several days or weeks until each child has had the opportunity to describe his object and share a drawing of it.)

ACTIVITY 3: Sharing Information

Have the children describe something that they found in the activity above and tell how it looked, smelled, sounded, and felt. It may be fun for the rest of the class to try to guess what is being described.

ACTIVITY 4: Exploring the World Outside

Take the children on a short (20-30 minute) walk around the outside of the school building. Encourage them to explore with all of their senses and try to find at least one thing that is particularly good for each sense. Worksheet A-1 may serve as a good guide for this activity. Show the children the worksheet before they go out so that they will have some idea of what they are really going to be looking for.

Smell – Air, cars, flowers, garbage cans, grass, tree bark

Hear – Traffic, birds, airplanes, talking, footsteps, dripping water

Touch – Buildings, cars, tree bark, anything that is safe to touch

See – Shapes, sizes, colors

Taste – Air, water

ACTIVITY 5: Sharing Ideas, Using Visual Arts

As soon as the children come back to the classroom, have them fill out Worksheet A-1, or ask them how they might share the things they discovered with each other and with anyone else who might come into the classroom.

TEACHER'S NOTE: The answer to this question may be an indication of how the children view the function of art. If they only mention telling someone about their experience, then take this opportunity to: (1) reinforce the idea of sharing, (2) point out that pictures are one of the best ways to share our ideas and discoveries.

Have the children select some of the items from worksheet A-1 and draw larger pictures of them for the development of a display or collage called "Our World". Put all of the pictures on a display board and have each member of the class "explore" the display during a general class discussion of the things that go together to make up the child's environment or world.

TEACHER'S NOTE: This activity may be very helpful in determining how each child perceives the environment, and in guiding the selection of future areas of emphasis. For example, if children did not include noise as a part of their environment, another short walk just to explore the "sounds of our world" may be appropriate.

EVALUATION:

When shown pictures of various kinds of neighborhoods, children will choose the one that most nearly resembles the one around their school and home. (Cut pictures from old magazines.)

If children were asked to try to tell what was in their lunch box or bag without looking at it, would they be aware enough of the multi-sensory approach to discovering the answer that they would feel, smell, and taste the ~~lunch without~~ looking at it.

If a right angle, a curve, and a square, were drawn on the board and the children were asked which one of these shapes they saw the most/least often in their walk, they would be able to give an answer that was satisfactory in the judgment of the teacher.

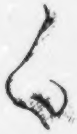
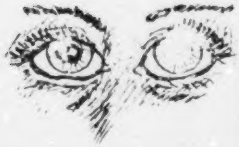
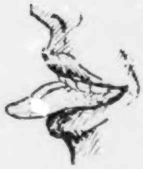
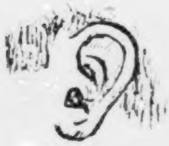
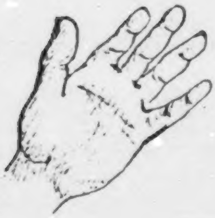
If children are given a chance to use models of the various things that represent parts of their environment, they will choose to build a model of their world that in the teacher's judgment comprises a true representation of the things that surround the child.

If asked as a class project to cut pictures of things they discovered in their environment from old magazines and make a very large collage to represent their world they would, as a class, select things that really did give a good picture of the immediate world of the child.

TEACHER'S NOTE: Each of the above may be used as a supplemental activity where appropriate, or can be used as a follow-up evaluation activity.

WORKSHEET A-1

Draw pictures of the things that can be identified by the sense pictured.

OUR 				
OUR 				
OUR 				
OUR 				
OUR 				

Section A LIVING THINGS Topic II

GOALS: After this lesson children should:

Identify as alive anything that needs air to breathe, food to eat, water to drink, grows or moves without assistance, reproduces itself, and eventually stops living.

Recognize the importance of organizing the things found in the world into groups that have some similarity, in order to be able to study them better.

Identify all living things as either a plant or an animal.

Begin to realize the relationship of living things to non-living things and to each other.

Begin to develop an awareness of the processes involved in solving a problem.

TEACHER'S NOTE: In Topic I, the children became aware of their world as a place that is made up of a *variety* of things. It is now necessary to help the children organize their world into groups of things that have some commonality. The most general way is to first divide the components of the environment into groups of living and nonliving things. Living things will then be subdivided into plants and animals.

ACTIVITY 1: Finding Solutions to the Problem of Environmental Organization

Give students the opportunity to consider how they might go about learning more about their world. Point out to them that they should really start to try to solve problems, and in order to do this they must first identify what the problem is. Help them, through initial question and answer sessions, to understand that in a world made up of a variety of things they must find a way to study groups of things that are similar because there would never be time to study each and every individual thing. The following questions will help to introduce this concept:

We have found in our exploration of our world that it is made up of many things. Do you think that we would ever have time to take each and every thing and study it by itself?

What other ways might there be to explore our world further?

If we had to put everything in our classroom into two groups, what would they be? Remember these first two groups would have to be able to accept everything in the classroom.

What do desks, pencils, paper, and walls have in common?

What can we say about all of them?

How about people, plants, pets, and insects? What can we say that would be true of all of them?

TEACHER'S NOTE: These questions combined with the use of Worksheet A-2, will help the children to develop the first set of study groups: Living and Non-Living Things.

Show the children Worksheet A-2 and ask them to think of two groups that all of the things on the worksheet might fit into.

When the children have determined that the first two divisions they are to make are living and non-living things, have them circle the living and leave the non-living unmarked.

ACTIVITY 2: Subdividing Living Things into Plants and Animals

Continuing to use Worksheet A-2, ask the children how they might divide the living things into two study groups. Have them put a check mark beside those things that are animals and an X beside those that are plants.

ACTIVITY 3: Studying Animals as Living Things

Ask the children how they might determine what all of the animals have in common. Do they know of other animals that may share some commonality like those on the worksheet?

Have two children who are obviously different in size and shape stand in front of the room and ask the rest of the class to describe how the two children are different.

After the children have explored differences and described them, have them discuss similarities. The following questions will help:

How many hands, feet, eyes, and noses do each of the two children in the front of the room have?

What kinds of things are the two people doing that are similar?

Are they breathing, moving, have they eaten something today, have they had anything to drink?

Are they growing? How might we tell this? (This is an excellent opportunity to start a growth chart for each child.)

Where did they come from?

Will we all eventually stop living?

Encourage the children to ask the same kinds of questions about the animals that they observe. Some opportunities for this kind of observation may occur when: there are animals, fish, hamsters, and gerbils in the classroom; the class goes on a field trip to a zoo, farm, or nature center; children observe animals that they see at home or on the way to and from school; the children see films of animals.

As children watch animals emphasize the fact that they are looking for "signs of life" things that will tell them what all living things have in common. Ask them if they have seen any animal that was alive that did not eat, drink, breathe, grow, reproduce itself, and eventually die.

Ask each child to complete Worksheet A-3. The children are to cut out the squares on the second page and paste them on the appropriate places on the first page. For example, the picture of a bird's wing and feet should be placed under the boy's feet, because this is how the bird moves.

TEACHER'S NOTE: The pictures across the top of page 5 show a human being standing, moving, drinking, breathing, and eating. The pictures on the second worksheet (page 6) show other animals doing the same kinds of things. This activity is designed to show the child the things that all animals have in common.

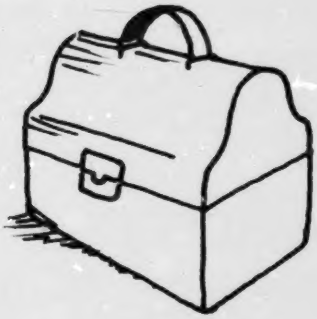
ACTIVITY 4: Studying Plants as Living Things

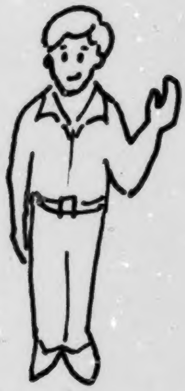
TEACHER'S NOTE: Young children very often associate life with unassisted movement and therefore do not realize that plants are alive. Help them to see that while plants do not, as a rule, move freely about, they still need the basic requirements of living things because they require air, water, food, and they grow, reproduce, and die.

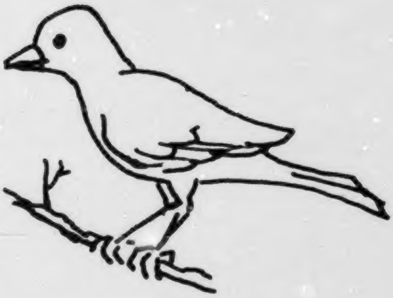
Using Worksheet A-4, page 7, give the children the opportunity to explore the school grounds or the block around the school building and look for different kinds of plants. Do not be too concerned if examples of all of the different kinds of plants are not found. This activity would best be done when the plants are in foliage and before the leaves turn color in the fall. If you are in an area where there just are no plants, use pictures or films or any kind of things you have available to help children find different kinds of plants.

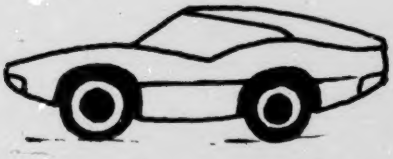
WORKSHEET A-2

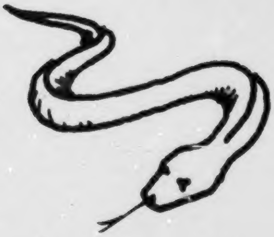
Circle the following things which are living.

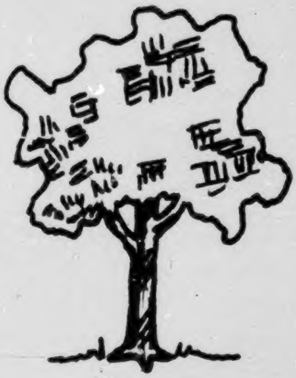












When children have finished the assignment of finding many of the plants on Worksheet A-4, have them select a crayon or water color and put in the colors that they observed on the plants. Then ask the following questions:

What color did most of the plants have in common?

Were all of the plants attached to something?

Why do plants grow in some places and not in others?

What conditions are needed in order for a plant to grow?

One way to demonstrate the air, water, and food requirements of plants and how they grow, reproduce, and die, is to perform an experiment to show the children what happens to a plant that is deprived of air, water, or food. This observation will be in terms of life functions. The plants will either grow and reproduce seed or they will die.

The following activity may be done as a demonstration where the children observe the results, or as an experiment where they participate in constructing and conducting the exercise. This decision will be based on the age of the children and the teacher's assessment of their interest and ability.

Materials needed:

6 small (6-8 oz) clear plastic glasses. These are now part of the picnic supply section of your local supermarket.

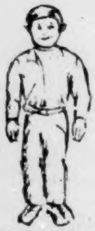
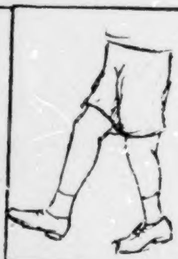
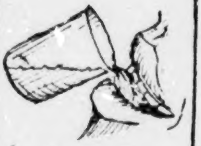
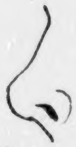
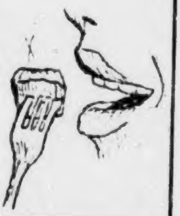
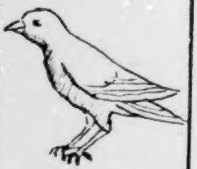
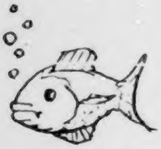
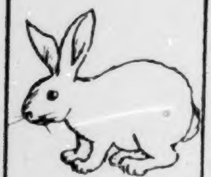
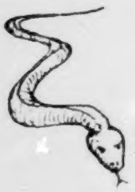
garden bean seeds.

6 small (6" diameter) paper plates. (These are just to put the cups on so that they don't leak onto the table or counter top.)

TEACHER'S NOTE: If you should decide to let the children participate in the experiment, make sure that all of the following procedures are done by someone.

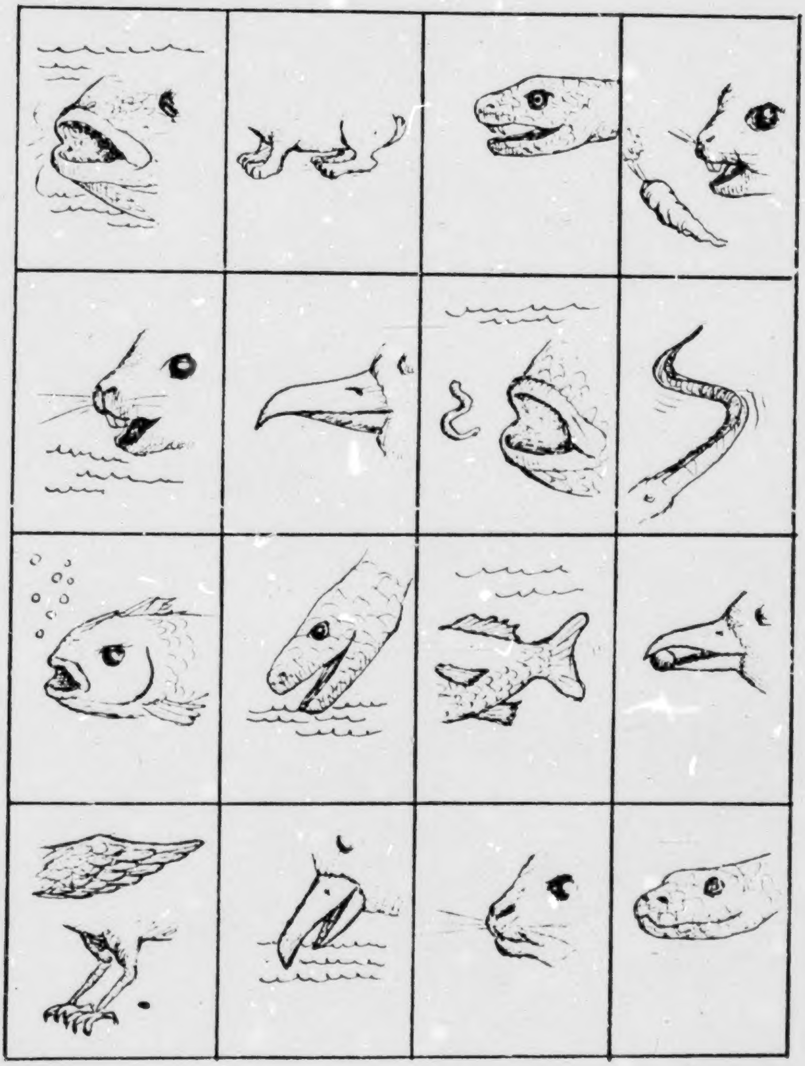
WORKSHEET A-3-1

Cut out the squares on WORKSHEET A-3-2 and paste in the appropriate spaces on this worksheet.

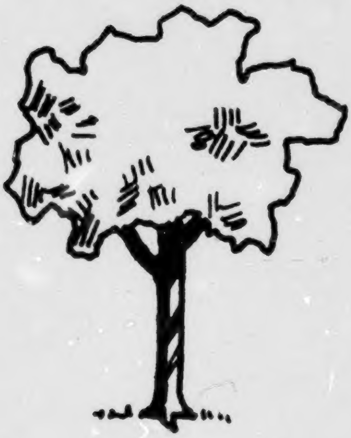
WORKSHEET A-3-2

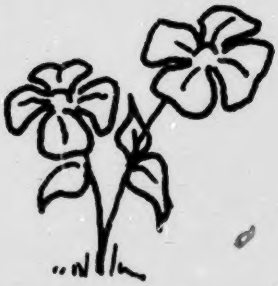
Cut out these squares for pasting on WORKSHEET A-3-1.

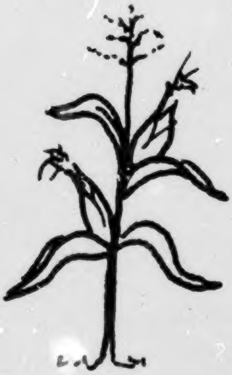


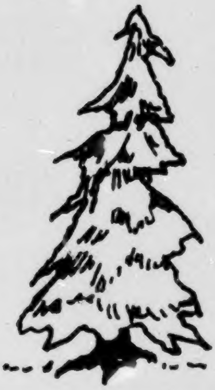
WORKSHEET A-4

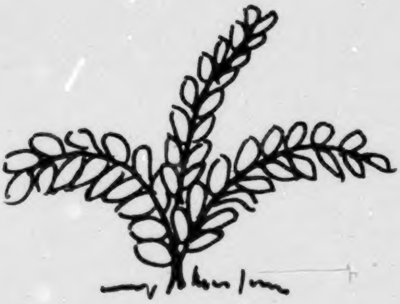
After observing the natural color of the following plants, put the proper color on each using either a crayon or water color.

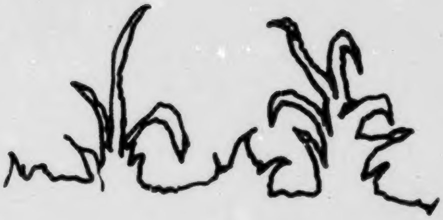












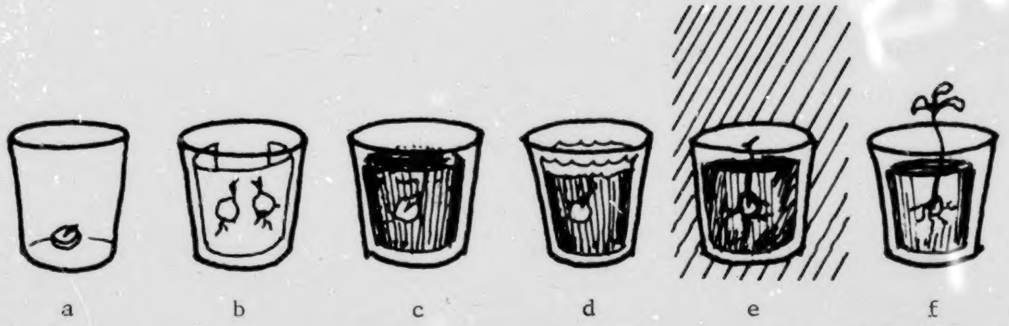


Figure A-2

Procedure:

Set up the following six demonstrations.

a. Seed, no soil, no water.

b. 2-3 seeds between moist blotting paper and inside wall of glass.

c. Seed planted against inside wall of glass with 3" of soil in glass. Do no water.

d. Seed planted against inside wall of glass with 3" of soil. Keep water level continually at soil surface.

e. Seed plated against inside wall of glass with 3" of soil; no light.

f. Plant in 3" of soil; normal bright light; watered whenever the soil has become dry to touch; and open to air.

Make sure the children know which life requirements are lacking for each plant.

a. No food or water.

b. Plenty of water, no food.

c. Plenty of food, no water.

d. Plenty of food, water, no air because soil is not draining and allowing air to enter soil.

e. Plenty of air, food, water, no light.

f. Right amounts of air, water, light—this plant should grow better than the rest.

TEACHER'S NOTE: The illustration above will help to determine how the experiment is going and to know about when to discuss with the children the effects of each variable.

Discuss the differences observed in each plant in relation to the particular treatment that the plant was given. The following discussion questions will help:

What differences did you notice in the plants that did not have enough food (soil), water, and light as compared to the plant that was given enough of all of these things?

EVALUATION:

When given the opportunity to use Worksheets A-2, A-3, and A-4, the children will indicate that they have developed an understanding of the concepts taught by being able to complete the worksheets.

When given the opportunity to separate many different kinds of things into groups, the children will start with living and non-living things.

When separating many living things into groups, the children will separate them into plants and animals.

Given the opportunity to list or select the common needs of all living things, the children will demonstrate that they know that animals need to move, plants need light, and both plants and animals need food, air, and water.

Section A NON-LIVING THINGS Topic III

GOALS: After this lesson children should:

Further develop their ability to recognize similarities and differences when asked to put things into study groups.

Recognize the similarities among non-living things.

Begin to develop perspective regarding the number and kind of non-living things in their world.

Recognize that living things become part of the non-living world.

TEACHER'S NOTE: This lesson will help children to explore and make discoveries about the non-living portion of their world, and will prepare them to form two more study groups, Natural Things, Topic IV, and Man-Made Things, Topic V.

ACTIVITY 1: Discovering Things About the Non-Living World

During a show and tell session have the children bring in one of their favorite non-living things to show and tell. If their favorite non-living thing cannot be brought into the classroom, have them either bring in a picture, or just tell but don't show.

Ask the children to describe similarities and differences between two selected items that they have brought into the classroom.

Ask the children if they can find in the classroom anything that used to be living but is now non-living. Items made of wood (desks, chairs, pencils, paper) will serve to show the children that not only are things in the environment either living or non-living, but that some things change from one form to another. Other examples would be sea shells, limestone, coral, and rope.

Using the questions that follow as a guide, have the children go on a short field trip around the school building and find some non-living things made of the following materials:

Can we find anything that is made of concrete, stone, or brick? What can we tell about these materials by touching them? Are they all the same shape? Are they smooth or rough?

What can we find that is made of metal? How does this feel as compared to the stones and bricks? Why don't we have stone cars?

What part of our world is made of glass? Where does the glass come from? Could we have a glass building?

Are there any other things in our world that are non-living that we have yet to discover? How about plastic? What about our clothing, tires on cars, rubber boots, leather belts?

Do we see any wood in our world that is non-living?

Are we missing anything? Have we identified air and water as a part of our world? How about sunlight?

Have the children make a small collection of non-living things to bring back into the classroom for further exploration and discussion.

ACTIVITY 2: Exploring the Properties of Non-Living Things

Using the non-living materials collected outside of the classroom, as well as items from the children's pockets and desks, have the children explore the properties of each of the items.

Have them answer these questions:

How do the things feel? Hot, cold, soft, hard, rough, smooth?

Do they bend? Why do some of the materials, when bent, stay bent, and others go back to the original shape?

Which of our non-living items have a smell?

Could we put our non-living items into study groups and learn more about them? What kind of things could we use to determine our groups?

How many of our non-living items have been changed by man?

How many have not?

TEACHER'S NOTE: Point out to the children that they have arrived at a place where another decision regarding organization of study groups is necessary. Non-living things are either natural or man-made. Each of these areas will be explored in the topics that follow.

EVALUATION:

Given the opportunity to check all non-living things on Worksheet A-2, children will select only those things that are non-living.

Given the opportunity to put the following items into study groups—a plant, an animal, a rock, a piece of wood, an article of clothing, an insect—children will make at least two initial groups, living and non-living things.

Given the opportunity to separate non-living things, selected by the teacher, into study groups, children will recognize the initial categories as natural and man-made.

Section A NATURAL THINGS Topic IV

GOALS: After this lesson the children should:

Be able to identify the basic natural resources as air, water, soil, rocks, minerals, plants, and animals.

Recognize change as a natural process, and understand that it is caused by conditions that surround the natural item.

Recognize the fact that natural things are in limited supply and must be used carefully because it takes a very long time to replace them.

TEACHER'S NOTE: The term *natural things* not only indicates an tem, but also may be used to indicate a process, such as the breakdown of rocks and decay of leaves.

ACTIVITY 1: Discovering Natural Change

Have the children go out on the school grounds, gather two small stones, and see if they can change them by rubbing them together. Look for stones that are piled up on one another and large rocks that have broken apart. While the exploration is going on, ask the following questions:

How might rocks in nature be rubbed together? (Rivers, streams, anything that moves rocks.)

How long would it take you to change enough rocks to make soil?

How would rocks in nature get crushed? (If many rocks were piled on top of one another, the force would crush some of them and make them smaller.)

Was there any difference in the rocks we found? (Some are soft, some hard, some round, some angular, some green, grey, brown.)

What would happen to some of this material as the rock particles get smaller and smaller?

How long do you think it would take for these changes to occur in nature?

TEACHER'S NOTE: If there is a stream or brook near the school hat is shallow enough to be safe and to permit rocks to be seen on the bottom, it will afford an excellent opportunity to study natural changes in rocks.

ACTIVITY 2: Exploring the Meaning of Natural Changes by Making Soil

Materials needed:

Enough rocks or pieces of rock about 3/4" to 1" in size to be able to have about 1-1/2" to 2" of material in each of 5 jars, glasses, or clear plastic containers of any size. Smaller containers will require less material. Break rocks with a hammer until there are approximately five different sizes, the smallest of which is about the size of sand grains. Protect eyes when breaking the rocks.

Procedure:

a. Arrange the rocks as shown above; sizes are progressively smaller as the numbers go from 1-4. Rock particles in 4 and 5 are the same size, but 5 has organic matter added to the rocks, any kind of leaf or grass material. Only 1-1/2" to 2" of material is needed in each container.

b. Place 2 bean seeds in each container about 1/2" under the surface and at the side of the container so the children can see what happens.

c. Add enough water to keep the material moist but not so much as to not allow material in 4 and 5 to "breathe."

d. Observe results. The following questions may help to guide the children's discovery in this experiment.

How do rocks break down naturally? (In streams by rubbing up against each other. By being piled one on top of the other. By freezing and thawing. By tree and plant roots forcing their way into small cracks in large rocks.)

What do you think will happen to the bean seeds in each of the containers?

What kinds of things are necessary to form a soil? (Small rock particles and organic matter.)

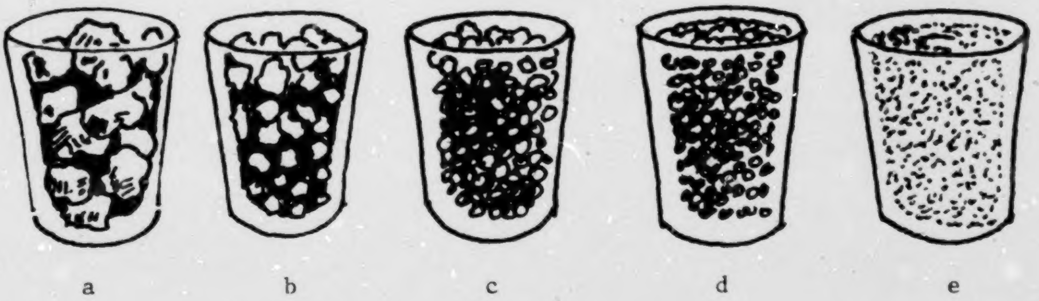


Figure A-3

How is soil formed in nature? (By the breakdown of rocks as in 1 above and the addition of organic matter by dead leaves falling, rotting wood, decomposition of dead animals.)

What would happen if rocks were so hard that they would not break down or if leaves, plants, and animals did not die and return to the earth?

Can you find things in your world that are natural products that are not being returned to the earth? (Desks, clothes.)

TEACHER'S NOTE: It is very important for the children to become aware of the tremendous time necessary for changes to occur in nature. The basis for the formation of natural resources is time. If a soil that took between 500 and 1,000 years to form is washed or blown away in a matter of minutes because of poor conservation practices, human beings as well as other plants and animals which depend on the soil are affected negatively until the soil is reformed. Take every opportunity to help the children to develop some concept of the time involved in natural change.

ACTIVITY 3: Finding Further Evidence of Change

Take the children outside one or several times for short discovery trips looking for change. The following suggestions may be helpful. The words in parentheses indicate the processes that cause the observed changes.

A place where soil is being formed. This may be found under hedges, in weed patches, on the floor of woodlots. If there is a place where leaves are piled up under plants and have been there for some time, have the children try to find the oldest leaf. See if they can find that place where the leaves stop and soil starts. (decomposition, soil formation)

A dead tree or branch that is rotting. (decomposition, breakdown)

Rust on any metal surface. (rusting, oxidation, breakdown, decomposition)

A place where water drips or runs constantly on the pavement or soil. (erosion, decomposition, building up of material from water, calcium sodium salts)

Gathering of small dirt piles in gutters. (How small soil particles are moved by gravity and water.)

Moss, lichen, or algae growing in damp places on the side of buildings or on rocks. (plants starting to grow, die, decay, and possibly aid soil formation)

Wind or weather changes of any kind. This may be combined with a weather unit, emphasizing any aspect that is appropriate to your class.

Building corners, steps, edges of paved areas starting to crumble. Cracks in paved areas. (weathering, breakdown)

Fire burning things. (burning, oxidation)

Sun heating things. (temperature change)

Freezing water, melting water. (freezing, melting)

Plants growing. (growth)

Bird and insect eggs hatching, growing, maturing. (reproduction, birth, growth)

Leaves turning colors, dying, falling to the ground. (death, decomposition)

TEACHER'S NOTE: Be especially aware of the opportunities to identify the processes: growth, birth, reproduction, decay, burning, temperature change, air movement, that are going on as well as the particular *evidence* of change.

ACTIVITY 4: Interpreting Evidence of Change

When the children come back to the classroom after discovering some of the changes and the way things change, ask them to draw something that they saw changing in all of its stages. How does it look now? How did it used to look and how might it look in the future?

Ask the children to describe in sensory terms the evidence of changes that they discovered. How did the dead leaves smell? How did the rocks in the stream feel as compared to those that were on the ground? These are just two of the many questions that might be asked to encourage each child to interpret change verbally.

ACTIVITY 5: Discovering the Effect of Surroundings on Change

It is necessary to expose children to the fact that change is natural and necessary, and that this change is affected by environmental forces surrounding the item that is changing.

To demonstrate how natural things change according to the environmental forces that affect them, put some ice in a jar and let it sit in the open air of the classroom. Do the same thing in an area of bright sunlight, or put it near a source of heat (not so close that the bottle will break). Have the children see which one melts/changes first, and then ask them to identify the environmental factor or condition that caused the change. This experiment may be done by putting two bottles filled with ice cubes in the sunlight and covering one bottle with black paper and one with white paper. (Black and white paint will do the same job.) This will show the children that color influences the rate of change by causing differences in heat absorption.

It is also quite easy to demonstrate how a living natural thing is affected by temperature and light. This can be done using two plants of approximately the same size in one of the following ways:

Cover one of the leaves on either of the plants with black paper to show how green plants change when deprived of light.

Put one plant near the sunlight and one away from the sunlight and notice that plants grow toward the light.

Put one plant inside and one outside in winter and see how temperature affects them.

ACTIVITY 6: Learning About Natual Resources

It may be appropriate at this time to establish another study group called natural things or resources. The following questions will help children to see the relationship of change to natural resources.

What kinds of things did we notice that change by growing? (plants and animals)

What kinds of things were broken down to form soil? (rocks, minerals, plants)

What did we discover that moved all by itself? (air, animals)

What did we discover that changed from liquid to solid? (water)

What are the things that occur in our world without being made by man? (plants, animals, soil, water, air, rocks, and minerals)

EVALUATION:

Given the opportunity to observe natural things, the children will be able to identify the item as either living or non-living and as a plant, animal, rock, mineral, air, or water.

Given the opportunity to observe things change, children will exhibit an understanding of the fact that the change was caused by a natural condition rather than a man-made one.

Given the opportunity to fill out Worksheet A-5, the children will demonstrate their understanding of the relationship of natural processes, such as, growth, death, decay, breakdown, by being able to draw a line from left to right between items that change.

Section A MAN-MADE THINGS Topic V

GOALS: After this lesson children should:

Be aware of the fact that man uses natural resources to make places in which to live and things that help him to be healthy and comfortable.

Be aware of the fact that all man-made things are still natural resources but have been changed in a way that is not a natural process.

ACTIVITY 1: Making Something from Natural Resources

Play Dough (No heat)
1 cup salt
2½ cups flour
Small amount of cooking oil. Enough water to make mixture the consistency of dough.

Play Dough (Using heat)
1½ cups water
½ cup salt
Mix and boil until salt is dissolved.
Remove from heat, add 1 tablespoon cooking oil and 2 tablespoons alum.
Add 2 cups flour and knead until smooth.

Paste
1 cup sugar
1 cup flour
1 tablespoon alum
1 quart water
Mix and cook until starch-like.
Remove. Mix in 3-4 drops Oil of Cloves. Cover and store.

Have the children make something that they can use. This can be cutting and pasting, or anything from building blocks to a paper weight. Try to make real the concept that man takes natural products and changes them to meet his needs. When the class has finished the experiment above, have them discuss the following questions:

What natural materials did we start with and where did they come from?

What processes did we use to change the materials?

What will happen to the material in the item we made once we are finished with it?

What would happen if we needed this man-made product but could not get enough of the flour, salt, or water?

ACTIVITY 2: Exploring the Things That Are Used to Make Up The Child's Man-Made World

Go on a materials hunt with the children to see how many different kinds of things are necessary to make up the community, neighborhood, town, city, block where they live.

Take the children outside for a short walk and try to find out how many things are made of the following materials: metal, plastic, wood, glass, stone, rubber, leather, paper.

Let them either draw pictures or list some of the many things discovered that are made of these materials. Encourage them to feel, listen, smell, and look at these things and to describe them in multi-sensory terms. Remind the children of the importance of sharing and communicating well.

TEACHER'S NOTE: This outdoor experience should last only 15-20 minutes or until the children have stopped discovering or lost interest in the original purpose of the experience.

After the class returns from the walk, the following questions may be appropriate:

What kinds of things did you find?

What were some of these things made from?

How do you think some of the materials were changed in order to make them into what they are now?

ACTIVITY 3: Playing "What Did It Used To Be?"

Show pictures of man-made things such as buildings, cars, desks, chairs, pencils, roads, clothes, and food, and ask the children to try to figure out what natural resources were used to make the product.

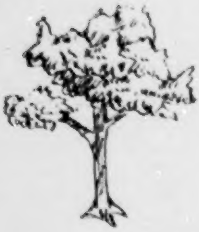
ACTIVITY 4: Reinforcing the Above Concepts with Dramatic Visual and Language Arts Activities

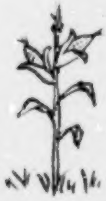
The class now has enough of a discovery resource to do many different kinds of activities over a long period of time that will reinforce the idea that: (1) the world has many things in it that are man-made; and (2) all man-made things come from natural resources. The following are some suggested reinforcement activities that may be used.

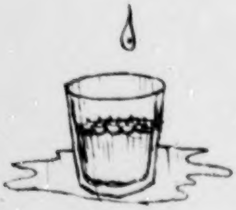
Dramatics: Have each child in a short skit be a natural resource and say how they turned from a tree to a desk, from rocks and

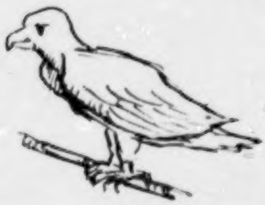
WORKSHEET A-5

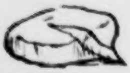
Draw a line from left to right between items that change.

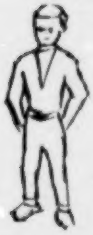


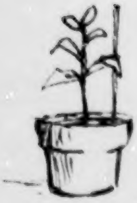


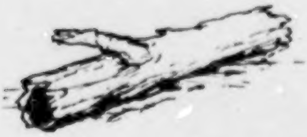


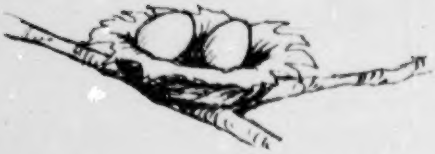


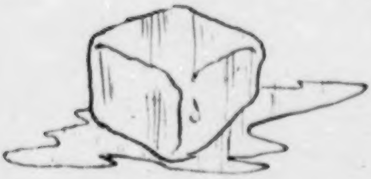


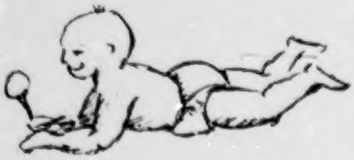


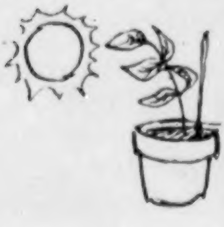












minerals to a car, from rubber to a tire, from sunlight to energy. For example:

The players:
1 tree
1 logger
1 sawmill operator
1 carpenter

Dialogue:
Tree: Stands tall with arms outstretched.
Logger: cuts down tree, takes it to sawmill and sells it to sawmill operator who
Sawmill Operator: saws tree and sells lumber to the carpenter who
Carpenter: makes a desk, chair, house

Have the children put on one or more of these short skits for another class in the school or for themselves.

Art: Have the children draw a story picture. For example: let them show how the building blocks got where they are, or how paper was made, or how their clothing was made.

Language Arts: If children have the necessary language arts skills, let them write a story about how a natural resource was turned into something that man uses.

TEACHER'S NOTE: The objective in all of these activities is to develop the concept that: (1) much of our world is man-made; and (2) even though it is man-made, we still depend on the basic natural things for our products.

EVALUATION:

Given the opportunity to discuss where man-made products come from, children will demonstrate by their comments that they realize that all man-made materials are derived from man's changing natural resources.

Given the opportunity to select man-made and natural products from Worksheet A-6, the children will demonstrate their ability to do this.

Given the opportunity to draw a line on Worksheet A-6 from the natural product to the man-caused/made change, the children will demonstrate their understanding that all man-made products come from natural resources.

Given the opportunity to answer this question: how long does it take man to use a natural resource compared to the length of time it takes nature to make it? Children will demonstrate by their answers that they are aware of the tremendous time necessary for a natural resource to develop and the very short time it takes man to change it.

Section A INTERRELATIONSHIPS Topic VI

GOALS: After this lesson children should:

Recognize the relationship between the living and nonliving parts of their world.

Recognize the relationship between natural and man-made items.

Recognize food chain relationships

Recognize interaction among living and non-living components of the environment.

TEACHER'S NOTE: In the first five topics the child has become aware of the general environmental situation that surrounds him and divided this situation into manageable, logical study groups. Topic VI, Interrelationships, will help the child to put these study groups into proper relationship with each other.

ACTIVITY 1: Discussing Needs

Discuss with the children what they would need to take with them if they were going on a trip into outer space.

Specific questions (such as: do we need to take some air, water or food? Should we take clothing, toys, and books?) may be helpful.

Point out to the children that what they would really have to do is take just about everything that they would need along with them.

In a way the spaceship would be like the earth because it would have to "provide" all of the materials necessary for life. Ask the children what would happen to the astronaut when things like air, water, and food ran out. Would they have to return to the earth and fill up again in order to survive?

Ask the children how the earth is different from a spaceship.

Why don't we run out of air, water, and food?

How does the earth keep mal[illegible]e air, water, and soil?

TEACHER'S NOTE: The following activity will help children develop general concepts by using small parts of the overall picture.

ACTIVITY 2: Building a Small Spaceship

Point out to the children that the spaceship they are going to build will really not go anywhere. It will recycle air, water, and food. It will be very much like our earth. Here is a suggested way to present this activity:

> Let's build a spaceship for a very small astronaut. We know that astronauts are animals just as we are, and that animals need certain things. We have discussed how they need air, water, and food. How could we build a spaceship for a small animal that would provide these things on a continuing basis once they were put into the craft?
>
> Let's perform an experiment to see how this is done. We will see how the parts of our world work together for our survival.

TEACHER'S NOTE: This experiment will allow the children to see an actual system where life is being maintained because of the interrelationship of natural resources – i.e., plants, animals, air, water, and soil. The purpose then is to demonstrate real interrelationship in a simple, direct, and identifiable manner.

Materials needed: (Cost, approximately $2.50)
1 fish bowl about 10" x 10"
1 female guppy
1 male guppy
1 small package of aquarium sand
1 piece of Saran Wrap or non-permeable clear material to cover the top of the fish bowl
1 bunch of Anacharis
1 bunch of Hari Grass
(All of the above materials can be purchased in a pet shop.)

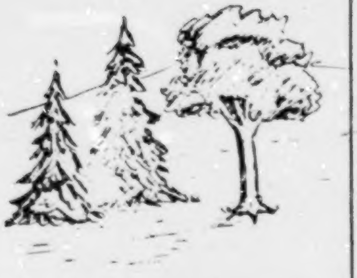
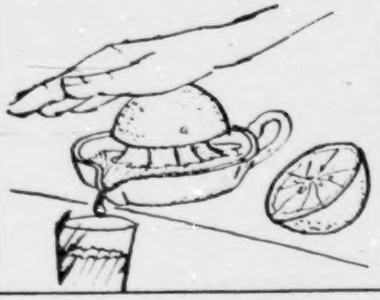
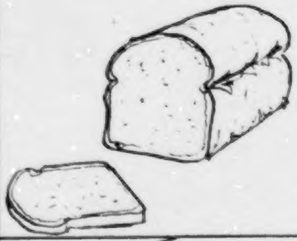
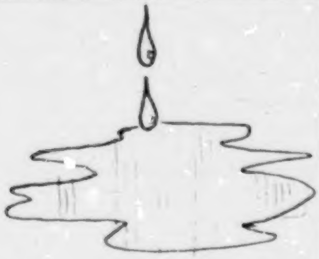
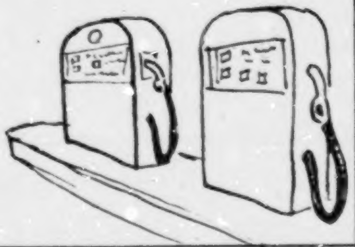
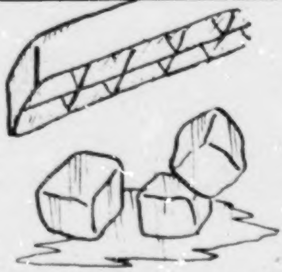
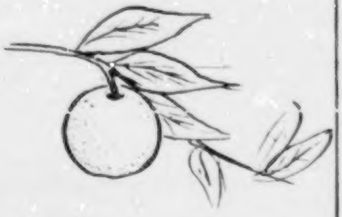
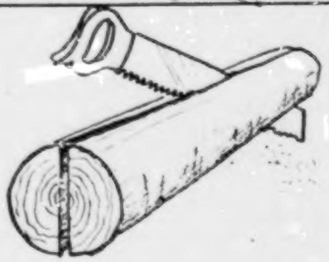
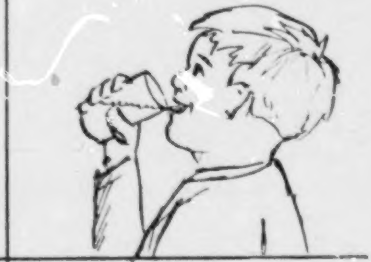
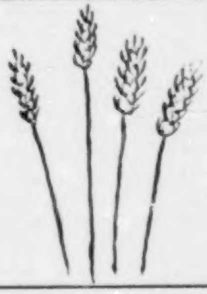
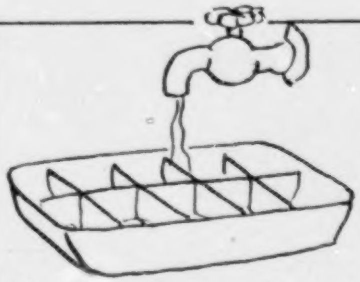
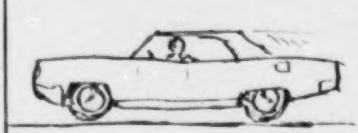
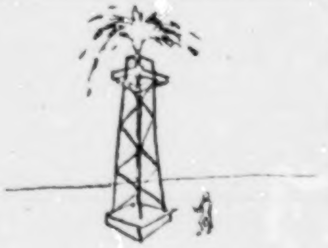
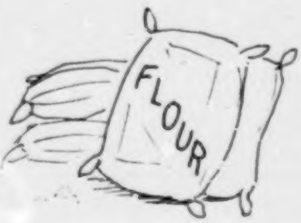
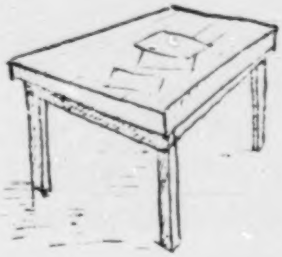
Procedure:

a. Fill the bowl with tap water to within 1-1/2" to 2" from the top and allow to stand at room temperature for 24 hours.

b. Rinse enough of the aquarium sand to cover the bottom of the bowl with 1" to 1-1/2" of the material. Put the sand into the bowl.

WORKSHEET A-6

Circle all man-made things.

c. Anchor plants in bunches in the sand. Do not be concerned if the plants seem to "fill up" the bowl, just make sure they are placed so that there is some open water on the surface.

d. Allow to stand until the water clears and particles settle. (About 15-20 minutes.)

e. Place the two guppies in the bowl, cover the top with Saran Wrap, and place near a window that will provide a good source of sunlight. Have a shade of some sort available to prevent the bowl from being overheated by direct sunlight. Any piece of cardboard of paper will do.

TEACHER'S NOTE: This experiment was tried in connection with the development of this curriculum guide and was most successful. The plants generated oxygen, the guppies ate the leaves, had babies which did quite well, and the whole system worked very nicely. However, any balanced system like this can go awry. For example, a fish may die from old age or disease. Things that are completely unrelated to the experiment may happen. Point this out to the children before starting so that they will be prepared should an abnormality occur.

The following questions may help guide the children in their discovery and observation:

What natural resources are in our world? This question should relate back to the children's original discovery of what is necessary to support life–air, water, food, soil, plants, animals.

What are the non-living and living parts of the system we are observing?

Where does the air come from? (Children should see bubbles rising from the plants during times when the aquarium is exposed to bright light.)

Where do the plants get the materials they need to make food?

What might happen if this experiment were conducted in a dark place?

What are the fish eating?

Would the fish eat other fish if they were in the tank? What might this depend on?

How long could each of the animals survive in their present situation? What does this depend upon?

What would happen if we put in many, many plants?

What would happen if we put 4, 6, 8, 16, or 32 fish in the fish bowl?

How is this little spaceship like our world?

What will happen to the leaves that fall from the plants onto the soil? Remember our experiment with the small rocks in Activity 3, Topic IV?

What happens to the food that passes through the fish?

Can you think of things that you have discovered outside that may be similar to what is going on in our spaceship?

What would happen if you took the plants out of the water?

What would the fish be deprived of?

ACTIVITY 3: Explaining Interrelationship and Survival

It is important to point out to children that while the survival needs of the small astronauts (fish) and real astronauts in a space capsule are the same – i.e., food, air, and water – the astronauts go about survival in a different way. Because their time in space is limited, they carry all food, water, and air necessary for their stay in space. They must return to the earth before their available resources are gone.

The earth is very much like a spaceship in that everything needed for the maintenance of life is on the earth and the earth is traveling through space and interrelated to the sun by gravity. Natural processes called interrelationships that start with the green plants and sunlight allow continuation of this journey without returning to another planet to "store up" food, air, and water. These processes will continue as long as the sun shines and man does not disrupt the natural relationships that surround him and are necessary for his survival.

ACTIVITY 4: Reviewing Necessary Activities

Review with the children any of the Activities 1-3 that may be appropriate at this time. Remember that the intent is to break the world down into study groups, not to have the children think that the parts of their world stand alone.

EVALUATION:

Given the opportunity to answer the questions in Activity 2, children will demonstrate that they understand the relationships that exist among the environmental components (air, water, plants, animals, soil) that they see in the fish bowl.

In discussing Master A-1, the children will demonstrate their understanding of both the natural and man-made processes.

Section A Topic VII

PEOPLE WHO TAKE CARE OF OUR NEIGHBORHOOD AND OUR WORLD

GOALS: After this lesson children should:

Recognize that there are men and women who care for and maintain the natural and man-made world, and that they make their living doing this.

Appreciate these occupations and recognize the importance of each one.

Begin to develop an awareness of the world of work in the natural resources in particular, and other occupational areas in general.

ACTIVITY 1: Talking About Caring For

Go over the meaning of the term "to care for." The following questions will help:

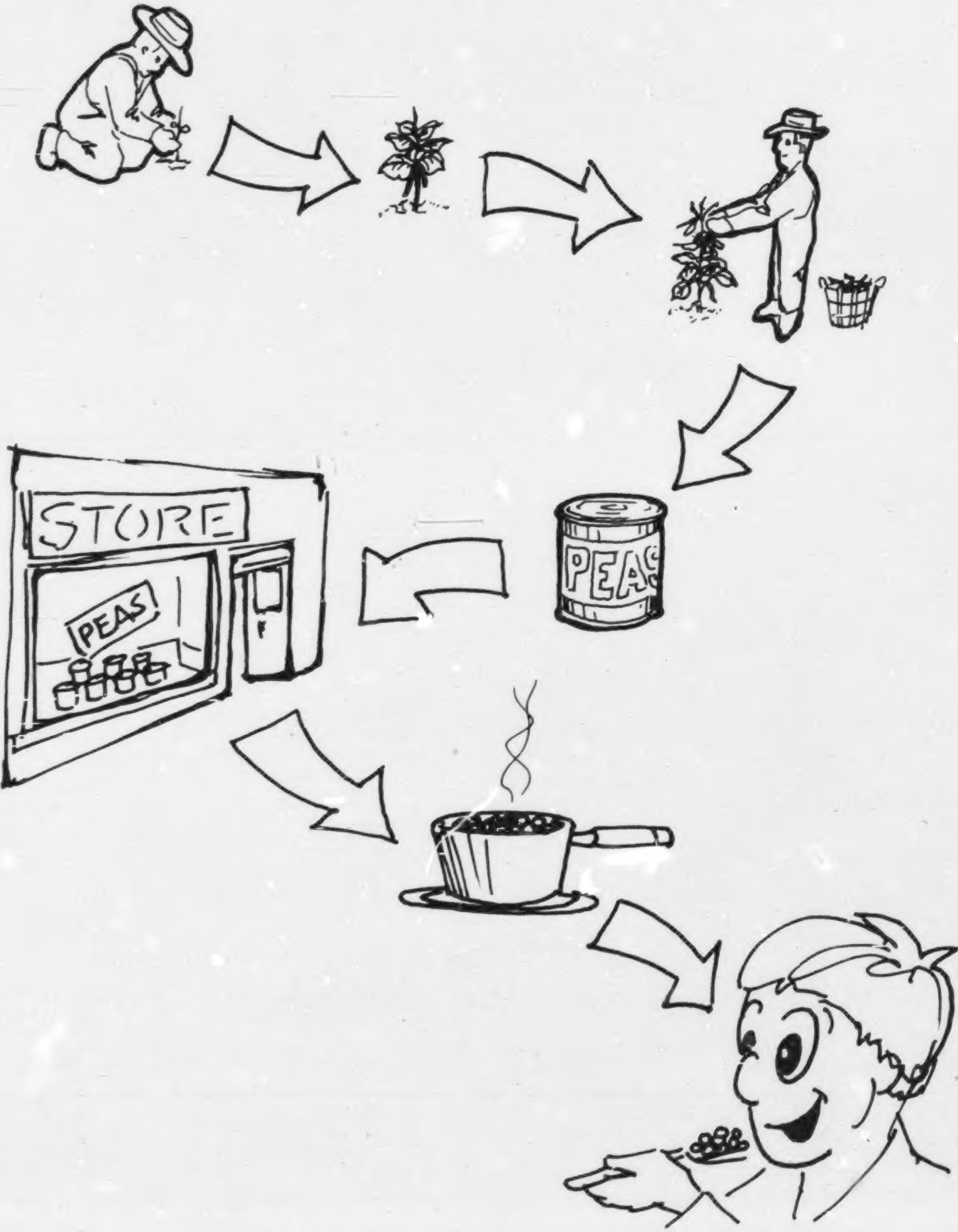
How should we take care of ourselves? We want to be clean, well fed, warm, and in good health.

How would we take care of our favorite toy? We know where it is. We keep it from being broken. We try to keep it clean.

What do we do to take care of our pets or plants?

Who helps us to take care of our classroom?

MASTER A-1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ACTIVITY 2: Learning About the People Who Care for the School

If the custodian in the school relates well to the children, it may be a good idea to have him come into the classroom and help the children understand how he takes care of the school.

What would happen to our classroom/school if we didn't have people to help us take care of it?

What other kinds of people do we know about who help us take care of the man-made world around us?

ACTIVITY 3: Exploring Other Occupations That Involve Taking Care of a Part of the World

Using old magazines or newspapers, have the children cut out as many pictures as they can find of people working. Reminding them how they have learned to divide information into study groups, ask the children to divide their pictures into groups of people who are caring for something (mechanics, garbage men, street cleaners, road repairmen, window washers, doctors, nurses, parents, camp counselors, gardeners, farmers, forest rangers, custodians, policemen, firemen, zoo keepers); and who are performing a service or producing something (bricklayers, mailmen, bankers, butchers, factory workers, tailors, and salesmen).

Have the children develop a collage or bulletin board of men and women who take care of their world. This would involve only those pictures of people who are caring for something. Let the children work in groups and each do a section of the display. Sections may be: people who take care of our world; people who make things, and people who perform services (such as teaching, selling, and deliveries).

Encourage the children to observe someone who is taking care of some part of their world and be able to come back to the classroom and tell the other children about it. This may happen over a long period of time. From these observations it may be appropriate to develop a list of people who take care of their actual surroundings.

ACTIVITY 4: Going on Field Trips to Find Out About People Who Take Care of Things

If a field trip is planned to a fire house, police station, or farm, this series of lessons may well fit into pre-trip and post-trip activities.

ACTIVITY 5: Figuring Out a Puzzle

Using Worksheet A-7, have the children cut out and put together the puzzles that match a person to his occupation. This worksheet is designed as a puzzle because there are some occupations that the children may not be aware of. This worksheet is more of a teaching aid than an evaluation tool.

Have the children discuss those occupations shown in Worksheet A-7 that involve taking care of natural resources and the man-made world. Have them figure out which of the following titles might apply to natural resource workers; fish protector, gardener, forester, air pollution tester, and refuse collector.

Help the children to see that there are many occupations in the field of environmental protection or care, and that because there are so many people in the world, people must constantly be on the alert for natural resource problems.

ACTIVITY 6: Helping to Take Care of the World

Ask the children how they might help to take care of their world, and what kinds of things they might do to show people they care.

Have the children go out on the school grounds and each pick up one piece of paper. It doesn't have to be very large. Chewing gum wrappers and things of that nature are fine. When the children come back into the room, have them smell a mayonnaise jar filled with fresh water from the tap. After this, have them put the trash into the water and close the top. Smell the water again each day until the point has been made that trash really does affect water.

Ask the children these questions:

> If there are enough trash men and street cleaners to go around, why do we still see litter and trash on our school grounds?
>
> Would you rather see the city or county spend money on more trash men or on more parks and play areas?
>
> How can all of us help to keep the places where we live, learn, and play clean?

The effects of litter may also be shown by using the bean seed and some good potting soil as in Activity 3, as compared to a bean seed in some soil that is about 1/2 litter and 1/2 soil.

EVALUATION:

Given the opportunity to answer the question: "Who helps to take care of our man-made world?" children will identify those who are a real part of the child's world and are truly "care oriented."

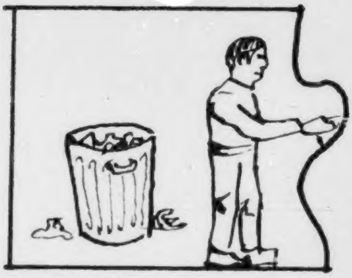
When children are asked, after Activity 5 in this topic, to identify those people who help us take care of our natural resources, they will demonstrate their ability to recognize those occupations.

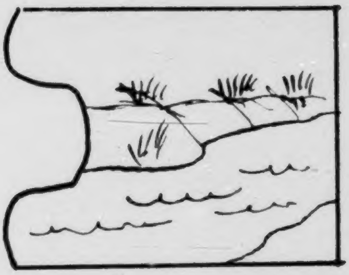
Given an opportunity to be exposed to an area on the school grounds or in the school that has litter, the teacher will see children demonstrate their awareness of responsibility for caring for the environment by voluntarily picking up litter and depositing it in a trash container.

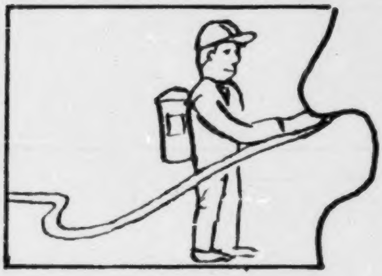
Given the opportunity to see his/her children use paper and having to throw it away, teachers will observe an increased use of trash cans and a decrease in the number of times children throw paper on the floor or ground.

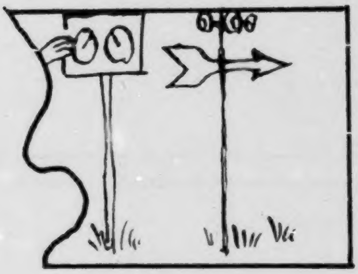
WORKSHEET A-7

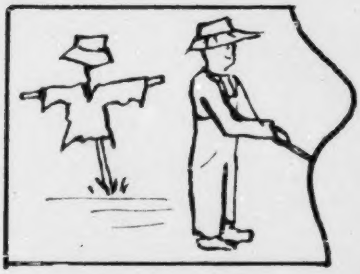
Cut out the puzzle pieces and assemble the puzzle matching the worker with his work.

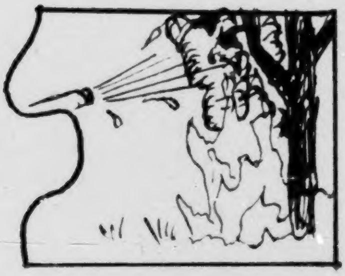


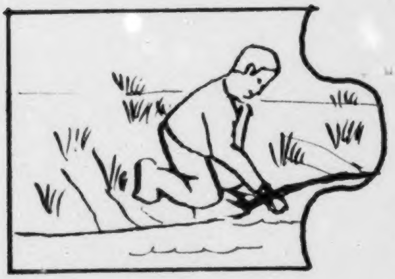


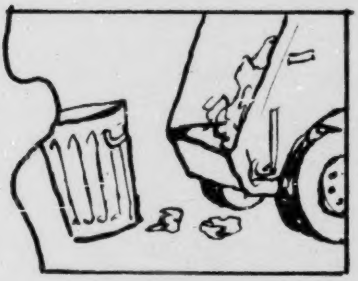


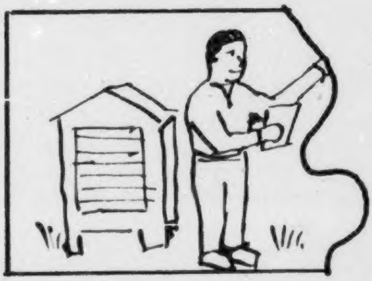


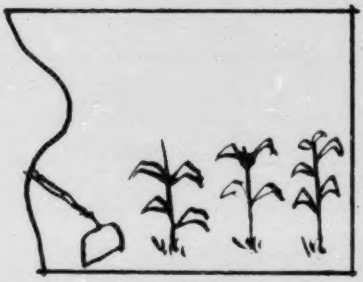












Section B NEEDS Topic I

GOALS: After this lesson children should:

Be aware of the fact that human beings have two kinds of needs—physical and emotional.

Know that the life-sustaining or physical needs are food, air, water, shelter or protection, and land space.

Know that food, air, water, shelter and/or protection come from natural resources.

Be aware of the fact that a happy, healthy life on this planet depends upon meeting both physical and emotional needs.

Know that needs are often interrelated.

TEACHER'S NOTE: Review Topic II, Section A, "Living Things," with special emphasis on the needs that all living things have in common, i.e., food, water, air, and the need to move, grow, and reproduce.

ACTIVITY 1: Identifying Needs

After the above review, ask the children the following questions:

What other kinds of needs do animals have? Let us take a look at ourselves and see if we can think of needs that we have that are not really necessary to keep us alive, but may well be necessary to keep us happy.

Do we need friends? Do we need love?

Do we need space to move? Do we need to play? Do we need time to think and be creative? Do we need to learn? Do we need to share?

TEACHER'S NOTE: The deductive approach may be successful in presenting these questions. For example:

What would we feel like if we had no friends? Do you think you could be very happy if you were the only person on earth and had all the food, clothing, toys, and money that you could ever want?

If the the above situation should arise what would you wish for most? (Children's answers to questions of this type may vary in that they will mention particular kinds of people, i.e., parents, sisters, brothers, friends, and pets. All answers, however, should be in the people category and will give you an excellent opportunity to point out that, without other people to share things with, material possessions mean very little. So friends should be considered both a need and a resource.)

ACTIVITY 2: Identifying Differences Between Needs–Conveniences–Comforts

Now that the children have explored the kinds of human needs, have them identify or define the words "need" and "comfort."

For the purpose of this discussion, a *need* is something that is absolutely necessary for physical and emotional survival. A *comfort* is something that appeals to people, may make life easier, or may give pleasure, but is not absolutely necessary for survival. We might call these happiness needs.

ACTIVITY 3: Making Decisions About Needs and Comforts

Using Worksheet B-1, have the children cross off or color over all of those things that they could get along without.

TEACHER'S NOTE: Worksheet B-1 gives teachers the opportunity to find out what students think is necessary for survival as well as happiness. It is important to note that many children will view things like toys, cars, and other things as absolute needs. The objective here is to help the children to become aware of the fact that the real needs are play and movement. Toys and cars are the things that man has produced to help meet the needs.

Continuing the use of Worksheet B-1, have the children put an (X) inside those boxes that picture a survival need and an (O) inside those boxes that depict a happiness need.

Now ask the children if they can put a priority on the needs that they have identified. Which of the things we have identified as needs are more important? Less important?

TEACHER'S NOTE: The exercise above will be completed in different ways by different children. A child who lives right next to a grocery store may not see the relationship between food and transportation as readily as one who lives far enough away from the retail food market. Use this exercise to determine what the child perceives as a need, and go on from there.

ACTIVITY 4: Combining Happiness and Survival Needs

Point out to the children that a happy life depends upon a proper combination of the things needed to eat, drink, and breathe as well as the things that make them happy. Again, some deductive exploration may be helpful here. Explore the need for space.

Mark out an area on either the floor of the classroom or out on the school grounds that is 25 square feet. The shape can be anything from square (5 feet by 5 feet) to rectangular, just as long as a particular amount of space is identified and defined.

Have the class sit around outside the defined space, and have one class member at a time get up and sit in the marked out area until there is no more room for anyone. Have the children count the number of people in the area and divide that number into the amount of square feet. This should come out to about one square foot per student.

TEACHER'S NOTE: This may be an excellent opportunity to introduce the word *population* and the term *population density* or number of people in a given amount of land space.

Ask the children what they like or don't like about being in a situation where they only have a limited amount of space.

The following questions may help to make the point:

What kind of things can you do better in a crowded area? (Talk, keep warm.)

What kind of things would you not be able to do if you had to stay in this situation, assuming that you would be able to have food, air, and water to take care of basic survival needs? (Couldn't move or exercise, would get sore, couldn't play, lie down, or go to sleep.)

What would happen if we couldn't have our air, food, and water brought in? Would we have enough space to grow food? Would enough rain fall on this amount of space to enable us to meet our water needs?

Do you think our behavior toward each other might change after a period of time in a crowded situation? (There may have already been some pushing and shoving as your children start to crowd into a small space. It may be appropriate to use incidents of this nature to emphasize the point that many people crowded into a small space may cause a change in the way they treat each other.)

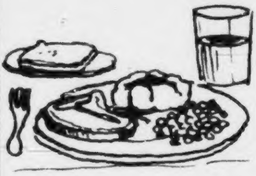
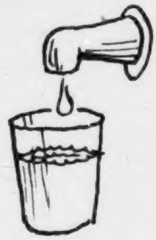
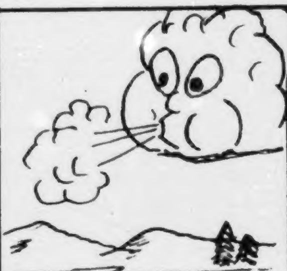
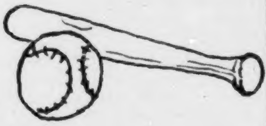
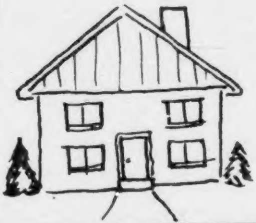
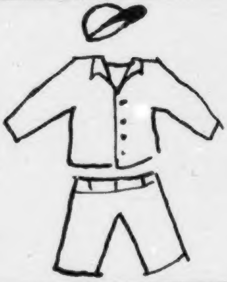
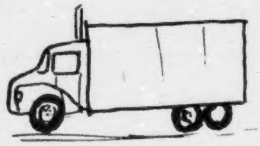
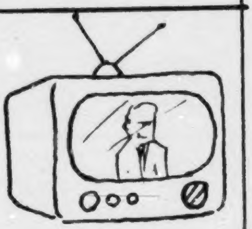
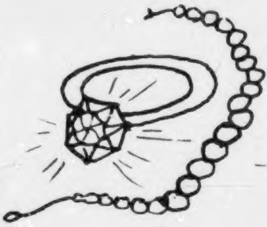
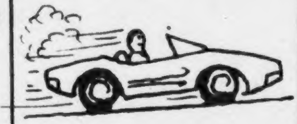
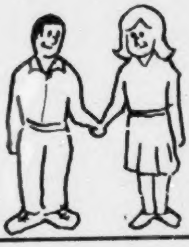
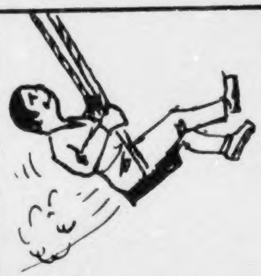
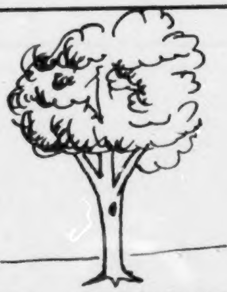
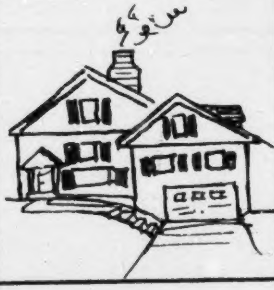
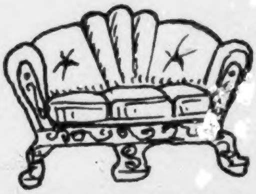
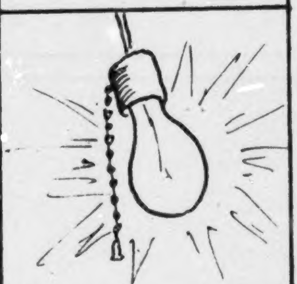
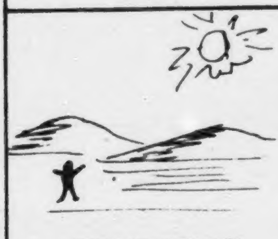
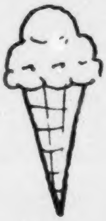
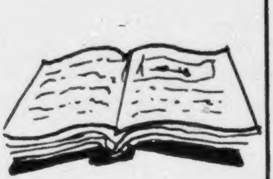
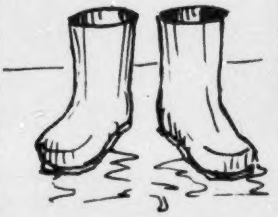
Ask the children to note the kinds of situations where they most often observe misbehavior. Are these situations crowded or uncrowded?

ACTIVITY 5: Using Mathematics to Figure Out Space Needs

A math opportunity: This is a very good opportunity to introduce or use some averaging and measurement techniques in connection with this lesson.

WORKSHEET B-1

Color all the things you could do without. Put an (X) inside those boxes that picture a survival need and an (O) inside those boxes that depict a happiness need.

Give the children the opportunity to work on very real word problems such as:

How much space do we have in our classroom per person?

$$\frac{\text{No. of sq ft (length X width)}}{\text{No. of people in class}} = \text{sq ft/person (room to work)}$$

How much space do we have per person on our playground?

$$\frac{\text{No. of sq ft in play area}}{\text{No. of children who use it at one time}} = \text{sq ft/person (room to play)}$$

The following measurement techniques may be helpful:

Teaching children to pace using set theory (see Figure B-1).

a. Mark off an area on the school grounds that is 100 ft long. This is a number line.

b. Have each child bring a pencil and some paper to write on.

c. Have each child walk from one end of the number line to the other. Count the number of steps and put this down on his paper.

d. Ask the following questions:

How many sets of your steps are in a 100 ft number line?

How far do you go with each step you take?

$$\text{Formula: } \frac{\text{Number of steps}}{100} = \text{No. ft/step}$$

ACTIVITY 6: Exploring the Need for Food

Have the children recall Activity 4 where they were crowded into the small area and ask these questions:

Suppose there were 30 people in the area but only enough food for 25 people. How would this affect the group?

Would the whole group have less to eat than they should, or would they simply decide to select 5 people and move them out? What if there were no other place to go?

What might be the situation in the space if the animals were rats or dogs or cats? Would they fight for the food? Would the weakest member of the group suffer the most? Would they decrease their own population?

TEACHER'S NOTE: Most animals naturally control their numbers, and this control depends entirely on the amount of food and other resources available to the particular population. Human beings, on the other hand, are able to solve problems in a way that might benefit or be for the good of the whole group, if these problems can be identified and people are willing to put forth the time and energy necessary to solve them.

ACTIVITY 7: How Much Food Does One Person Need?

Food requirements for an individual always depend on the amount of energy used by that person per day. If a child is very active or has a high metabolic rate, he will burn up more energy than one who is not active or has a low metabolic or energy-using rate. Energy is measured in calories. *Calories* are units of measure that tell us how much energy has been used. They are like feet, inches, and pounds.

TEACHER'S NOTE: The technical definition of calorie is the amount of heat required to raise one liter of water (a little more than a quart) one degree centigrade.

The average child in the third and fourth grade will need about 2,100 calories per day. Ask the children to figure out how many calories they are using per day. Use a calorie/food chart and have each class member list the kinds and approximate amounts of food they eat for one day. Figure total calories and then average them for each class member. Have the children compare the amount of food they eat to the amount of activity they have. Point out to the children that each person will vary in the amount of calories they need, since individual calorie requirements depend on basic metabolic rate and amount of energy needed.

Food Value: Not only are proper amounts of food necessary for energy requirements but food must also have materials that enable the body to grow and function properly.

Essential substances in all foods include carbohydrates, fats, proteins, minerals, vitamins, and water.

The following list shows how the body uses each of the above:

Carbohydrates and fats–Fuel for energy
Water–Body structure
Proteins–Body building (muscles)
Minerals–Bones, blood, glands
Vitamins–Regulators that help control the way our body works

How do we know we are eating the right kinds of food?

A good guide to proper nutrition and one that fits into the study group format is the basic four food groups:

1. Milk and milk products
2. Meat, poultry, fish, or eggs
3. Bread, flour, cereal (whole grains)
4. Fruits and vegetables

If one eats food from all of the above groups in the proper amounts he will have what is called a *balanced diet* – that is, one that will supply both the body's energy needs and the materials needed for growth and proper functioning.

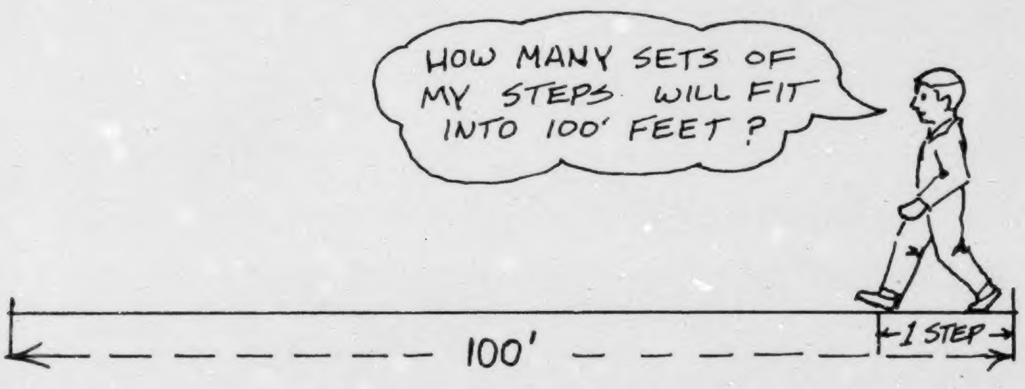

HOW MANY SETS OF MY STEPS WILL FIT INTO 100' FEET?
100'
1 STEP

Figure B-1

TEACHER'S NOTE: Use any materials or information available and appropriate to help children understand why they need food and the kinds and amounts needed. Suggestions would include science curriculum guides on health, as well as information and help from the school nurse or physical education teacher. The important thing here is to have the children become aware of the need for food in the proper amounts and kinds.

ACTIVITY 8: Exploring the Need for Air

Food taken into the body is actually burned just like the gas in a car or the wood in a fire. Anytime something burns, it requires oxygen from the air. The following experiment will show this to the children.

Procedure:

Light a candle and put a glass over it until it goes out. Ask the children what happened. Why did the candle go out?

Relight the candle and put the glass back over it. Just as the flame starts to go down, tilt the glass up and allow more air in. This will allow the flame to burn brighter. This is like breathing As air is used we take another breath and replenish it.

The amount of air needed is like food in that it depends upon the amount of fuel (food) being burned and this depends upon the amount of work we are doing.

Ask the children:

Why do you breathe more often and harder when you run than when you are sitting still?

EVALUATION:

Given the opportunity to answer the question: What are two things we all need? children will demonstrate their awareness of physical, emotional, or psychological needs.

Given the opportunity to choose between true needs and comforts, children will select food, air, space, and water as true needs and other things as comforts, wants, pleasures or whatever term is satisfactory to the teacher.

Given the opportunity to answer the question: why do we need food, air, water, space? children will demonstrate a knowledge of facts that are appropriate to their learning level.

Section B NATURAL RESOURCES Topic II

GOALS: After this lesson children should:

Know that natural resources fall into seven basic study groups or areas which are air, water, soil, plants, animals, minerals and mineral fuels, and land space.

Be aware of the relationship that exists between natural resources and the physical needs of man.

Have a stronger understanding of the interrelationships among all natural resources.

Develop an understanding of the word *resource* and the difference between natural and other resources.

ACTIVITY 1: Understanding Wise Use of Resources

The development of a wise use concept with children starts by using something with which they all are familiar – words. Point out to the children that language is a very valuable and important resource, and that it should be used well. Ask the following questions:

What are some of the ways that we use our language and words?

Sharing ideas, communication, learning from the written word, expressing our feelings and emotions?

What ways might we use words unwisely? By talking when we should be doing something else or by saying something unfair that may hurt someone else's feelings? By writing on the walls of buildings or on desks and chairs?

TEACHER'S NOTE: It may be appropriate at this time to review Section A, Topic I, Activity 3, "Sharing Information".

What other kinds of things do we have that are not really products or objects, but should be valued.

Time: Time may be one of our most important resources. Are we using our time well?

Friends: How unimportant everything would seem without other people to share things with. How do we use ability to make people happy?

Love: Do we spread our love around? Are we aware of the importance of having people love us? How do we treat the people whom we love? What makes us love someone?

Thoughts: Do we use our ability to think as best we can? What are some of the ways we use our thoughts wisely and unwisely?

Resources: Ask your children to define the word resources. Using ideas above, help them to develop the concept that *a resource is* anything that is available for valued use or has human utility.

What other kinds of things do we have to use?

Review the needs of living things with the children and ask them to list the things that they use to meet these needs. Worksheet B-2 is suggested as an aid in this effort.

ACTIVITY 2: Exploring Things That Are Used

Give each child a copy of Worksheet B-2.

Have the children keep the sheet for 2 to 3 days and as they go about their daily routines, have them list the things that they use or see being used to accomplish the activities listed on the worksheet. Point out to the students that this assignment is a basis for discussing resources in general, and that they can put down as many or as few items after each activity as they want to.

The purpose of this exploration and discovery activity is to reinforce the resource-use relationship and to give the children an opportunity to think about where the things they use come from and the way they are developed.

After the children have completed their lists, discuss the discoveries with the whole class, and encourage the students to fill in on their worksheets new thoughts from the discussion.

ACTIVITY 3: Discovering Where Resources Come From

Define the word *natural* as something that occurs without man's intervention or is a product of a natural process.

A natural resource is something we use that occurs naturally, without man causing it to occur.

Using Worksheet B-3, take the children on a short walk around the school or through the community and have them rediscover some of the things they use and try to list them next to the natural resource that was used to make them or to make them work. Some items will be put under several natural resources.

WORKSHEET B-2

List the things that you use to accomplish these activities.

What Do We Use For:

Eating	
Sleeping	
Moving Transportation	
Drinking	
Playing	
Communicating	
Learning	
Sheltering & Protecting	
Energy	
Cleaning	

WORKSHEET B-3

List things in your community next to the natural resource that was used to make them.

What Do We Make From:

Air	
Water	
Soil	
Plants	
Animals	
Minerals	
Space	

Discuss the children's discoveries with them and ask them if they discovered anything at all that was made from something not on the list.

TEACHER'S NOTE: This question may lead to some interesting discussion and some excellent teaching opportunities. For example, what if a child should find something made of plastic? It will not be obvious to the child where plastic comes from or what natural resources are used to produce it. Many answers to these questions can be found in the library under "Uses of Wood," "How Steel is Made," and other articles. Give the children the opportunity to answer the less obvious questions by doing a little research into the matter. Encourage them to use the problem-solving approach.

EVALUATION:

Given the opportunity to define the word *resource*, the children will demonstrate an awareness of the fact that a resource is anything that has human utility or value.

Given the opportunity to define the term *natural resource*, children will demonstrate their knowledge of the fact that natural resources are those things that occur naturally and are used to sustain life.

Given the opportunity to complete Worksheets B-2 and B-3, children will perform these tasks to the satisfaction of their teacher.

When asked to put the natural resources into study groups, the children will demonstrate their knowledge of the fact that the natural resources are air, water, soil, animals, plants, minerals and land space.

Section B

Topic III

CHANGES IN NATURAL RESOURCES

GOALS: After this lesson children should:

Understand the environmental effects of natural resource use that involves changes that are not caused by man but are a part of natural process.

Understand that man made changes often have the effect of removing material from the natural resource reserve and that these changes can be physical or chemical.

Understand that there is a limited amount of matter and that it must be recycled in order to have enough natural resources.

ACTIVITY 1: Discovering What Matters Most with Matter

What matters most with matter is that it is finite – there is only so much to go around.

Fill three or four clear drinking glasses with different kinds of material – dirt, marbles, sandpaper – anything will do as long as it is matter. Place the glasses in front of the room and ask the children what all four things have in common. What can be said about all of them? Do they have weight, and do they occupy space?

Define *matter* formally as anything that occupies space and has weight.

ACTIVITY 2: Understanding Physical Changes in Matter

Physical change is any change in size, shape, color, or texture, with the basic natural product or matter remaining what it was to start with.

Using modeling clay, have the children make anything that they want to so long as it would be useful to them or to someone else. Pencil holders, paper weights, or ash trays will do.

When the children have finished, ask these questions:

How did you change the clay?

Did you change its size, shape, weight, texture?

Is it still clay?

Is clay a liquid, a solid, or a gas?

Does the clay have weight and occupy space?

What will happen to the clay when we are finished with it? Can it be used again?

How do we change wood into the things we can use?

Ask the children to look around the classroom and find things that were once a tree. Desks, tables, chairs, pencils, papers are all good examples. Of all these things, which one has changed the most? Paper?

ACTIVITY 3: Making Paper

Materials needed for each 4" x 4" sheet of paper:

100 wooden matchsticks or pieces of soft wood the size of matchsticks.
1 glass jar that will hold the matchsticks and bleach, and will fit into the coffee can.
1 piece of window screen, 4 " x 4 "
1 one-pound coffee can
1 cup of laundry bleach (with chlorine)

Procedure:

a. Break off all match heads. Take them outside and burn them or otherwise dispose of them in a safe manner.

b. Place matchsticks and 1 cup of bleach in jar and put cover on jar loosely.

c. Paint coffee can flat black. (This will cause the reaction to occur faster.)

d. Place jar inside of can and cover the top of the can with the lid.

e. Place the can in a sunny spot for 2 to 3 days, until wood fibers start to be suspended in the solution when the jar is slightly shaken.

f. When the whole solution is filled with fibers, stir the solution with a stick to loosen any remaining fibers from the matchsticks.

g. Using tongs, remove the matchsticks from the solution.

h. Allow the fibers to settle to the bottom of the solution.

i. Very slowly pour off as much bleach as possible. Some fibers will be lost but there should still be plenty left to make paper.

j. Add one cup of water to the fibers and shake until all fibers are in suspension.

k. Allow fibers to settle and pour off "rinse" water.

l. Add another cup of water and shake again, until all fibers are suspended.

m. Pour the solution into a flat pan that is large enough to hold the 4" x 4" screen. Slowly move screen around until fibers have completely covered it.

n. Gently lift the screen out and place it in a warm (not airy) place to dry.

o. When the material is dry, scrape one corner gently with a fingernail until it comes away from the screen, then gently remove the completed sheet of paper.

TEACHER'S NOTE: Regular bleach is about 5 percent sodium hypochlorite. If the children do this experiment, make sure that they do not get the bleach into their mouth or eyes, and do not breathe the fumes for a long period of time. For third and fourth graders, this may be a teacher-centered demonstration rather than a student activity.

Physical changes usually do not have the same kind of effect on the environment as do chemical changes because they are really only a rearrangement of a naturally existing material.

Have the children look at the fibers in the sheet of paper and point out to them that even though the wood has changed form, it is still basically wood that has been rearranged.

ACTIVITY 4: Understanding Chemical Changes: Making Charcoal

Chemical changes are those that actually remove a natural material from the resource bank by converting it to energy, or cause a material to form that is so different and so strong in its construction that it may not go back into the natural cycle for a very long time.

It may be appropriate to discuss atoms and molecules with your students at this time. This decision will depend on the science curriculum schedule for the school system and the teacher's assessment of the readiness of the children.

Charcoal is made by the burning of wood in a situation where the amount of air is controlled. There is a very good opportunity here for a social studies lesson.

The production of iron in this country used to depend on the production of charcoal. Why did they use charcoal instead of coal or wood? Why is charcoal used for grilling food?

Charcoal is made by a man called a *charcoal burner.*

Prepare an overhead transparency from Master B-1 and explain the production of charcoal to the children. The following steps may be used as a guide:

Wood, generally hardwood, was cut into lengths of about four feet and stacked in a circle with a hole left in the middle. This same procedure was followed on the second level of the charcoal hearth (Frame A).

The whole thing was covered with leaves and dirt except for a hole in the very top. This hole was used to control the amount of air that was allowed to get in (Frame B).

The fire was started in the center and allowed to burn very slowly. The charcoal burner's job was to keep the fire going and to control the amount of air going into the fire (Frame C).

After about 2 weeks the wood was turned to charcoal and was ready to be transported to the iron furnace for use in making iron (Frame D).

TEACHER'S NOTE: There are several activities that may make thi material more meaningful to the children. The most important poin to make is that there was a definite relationship between trees an iron production.

Mathematics problems may be developed from the followin information:

A *cord of wood* is a pile 4 feet high, 4 feet wide and 8 fee long.

It takes 12 trees that are 24 feet high and 8 inches around t make 1 cord of wood.

It takes 1 cord of wood to make 15 bushels of charcoal.

It takes 180 bushels of charcoal to produce one ton of iron

Discussion points:

Energy given off when charcoal is used is not recyclable bu the actual matter that made up the wood is. The carbon hydrogen, and oxygen are changed and put back into th environment as either smoke or ashes. Natural processes the turn this matter back into wood material and photosynthesi stores more energy in the wood.

TEACHER'S NOTE: The activities above are examples of how ma has changed parts of his environment to meet his needs. It is ver important to point out to the children that man changes things ver fast. If the climate gets too cold for him he simply gets into a car o plane and moves on, or goes into a heated building, or puts on coat. All of these solutions to the problem of being cold require tremendous use of natural resources, whereas natural chang through adaptation occurs rather slowly and, from our point o view, much more tragically. For example, caribou are migratin animals. Each year they must move from one range to another i order to meet their needs. If, for some reason, they were deprived o the ability to move, there would be a few individuals in the her that would be able to tolerate a particular set of conditions wher the herd was located. These individuals would be more likely t survive and produce offspring which would, through heredity, have similar tolerance for these conditions. Over a long period of time th animal would change but the resources would remain the same. Thi is not the way of man. He changes very slowly, but can chang resources very rapidly.

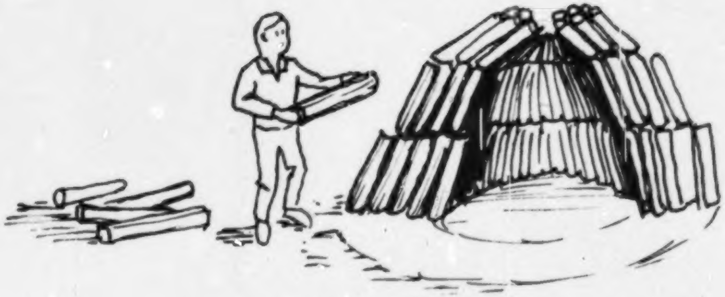
EVALUATION:

Given the opportunity to define matter, children will say o write "matter is anything that has weight and occupies space."

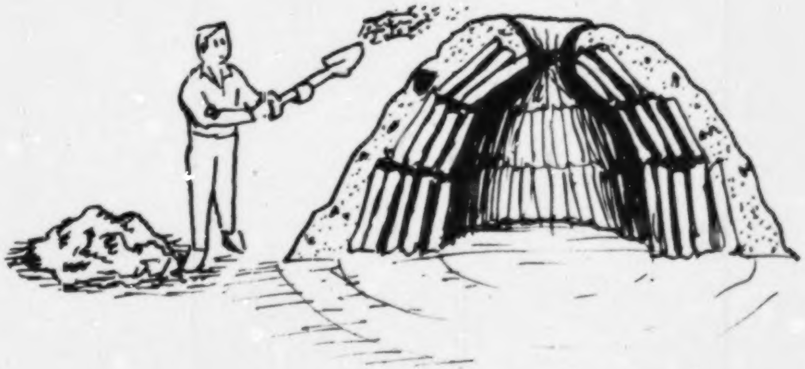
Given the opportunity to observe chemical and physical change selected by the teacher, children will be able to differentiat between the two and to describe the environmental implication of each kind of change to the satisfaction of their teacher.

Given the opportunity to answer the general question "Wha happens when material is used for energy?" the children will giv answers that indicate an understanding of the fact that energy i released, never to be returned, but that "matter" or materia does return to the environment.

MASTER B-1



Frame A



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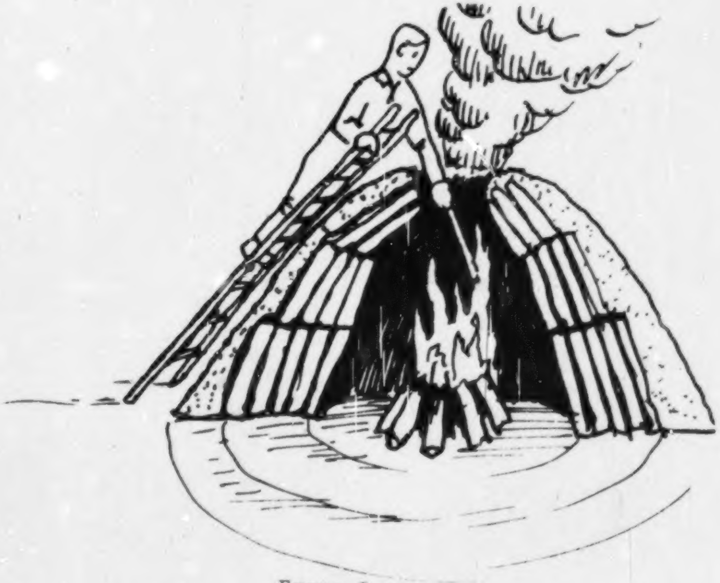

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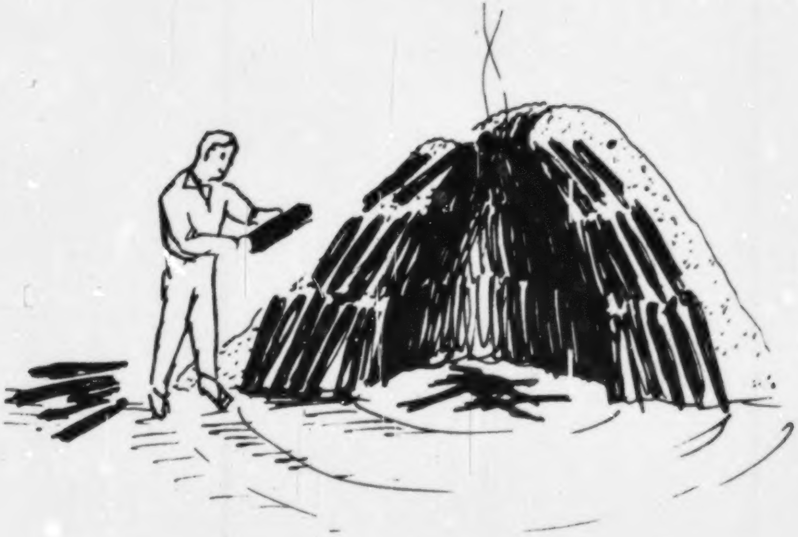


Frame D

Section B

THE EFFECT OF MAN'S USE OF NATURAL RESOURCES

Topic IV

GOALS: After this lesson children should:

Understand that man's use of natural resources has a qualitative and quantitative effect on them.

Explore and understand their own personal effect on the use of natural resources.

Understand the need for man to use natural resources wisely.

ACTIVITY 1: Exploring Individual Use of Water

TEACHER'S NOTE: The exploration of individual water use will require either a review of the measurement techniques involved or the teaching of these techniques at this time.

The children should know or be taught that:

There are 16 ounces in 1 pint.
There are 2 pints in 1 quart.
There are 4 quarts in 1 gallon.

Obtain some 8 ounce plastic or paper cups from any grocery store along with pint, quart, and gallon containers. Each child will need a cup.

The following is an example of how this may be presented.

We are going to figure out how much water we use per day as a class. First, let's consider some of the ways we use water.

We drink some. We wash with some. We use some to carry our waste products away when we go to the bathroom.

Procedure for Measurement:

Some of the mathematical tools we will be using will be measurement, ratio and proportion, and averaging.

In order to measure we must have a container that we know something about. The cups that you have been given hold 8 ounces of water. It takes 4 cups of water to make 1 quart and 4 quarts to make 1 gallon.

Question: How many cups are in a gallon?

Answer: 4 cups/quart x 4 quarts/gallon = 16

We want to use gallons for our final figure because it is a much easier set to remember.

There are many ways we could measure the amount of water we use, but we want to try to figure out the way that will give us the best answer with the least difficulty.

We could have every person in class simply measure each and every drop of water he uses and record the results, but this would be very time consuming and difficult to do. Instead, we will develop a way to take samples of how much water the average person uses for the three things mentioned at the beginning of class.

An average is one number that stands for a series of numbers. If the numbers in the series are all the same, then the average is that number. Usually thhe numbers in a series are not the same. Then we add the numbers and divide the total by how many numbers there are in the series. This gives the average number. For example:

If we have 5 people who drink the following amounts of milk per day – (1) 12 oz, (2) 15 oz, (3) 10 oz, (4) 12 oz, (5) 16 oz, we could say that the average for this group would be 13 oz of milk per day.

Officials of our town, city, or country must figure out how much water the community needs per day, month, or year.

Have the children make a chart for keeping their records. Design this chart according to the particular need of the class. It may look something like Figure B-2. Have the children make a chart for each day of the experiment.

DAY 1

	1	2	3	4	5	6	7	8	9	10	11	12	T	A	Oz	Qt	Gal
Drink																	
Wash																	
Bathroom																	

Total ____________

Figure B-2

Numbers:	Number of times
T:	Total times
A:	Personal Average (see below)
Oz:	Total ounces for activity
Qt:	Total quarts
Gal:	Total gallons
Total use:	Add up all gallons

$$\text{Average/day/person} = \frac{\text{Total Use}}{\text{No. of Days}} = \text{Average amount per person per day}$$

The first thing we must do is figure out how much water we drink on the average. This can be done during the school day. Pass out the plastic glasses or paper cups and ask the children to use only these whenever they get a drink during the school day. Mark the cups in 8 even segments so that a child can determine how many ounces he or she drinks.

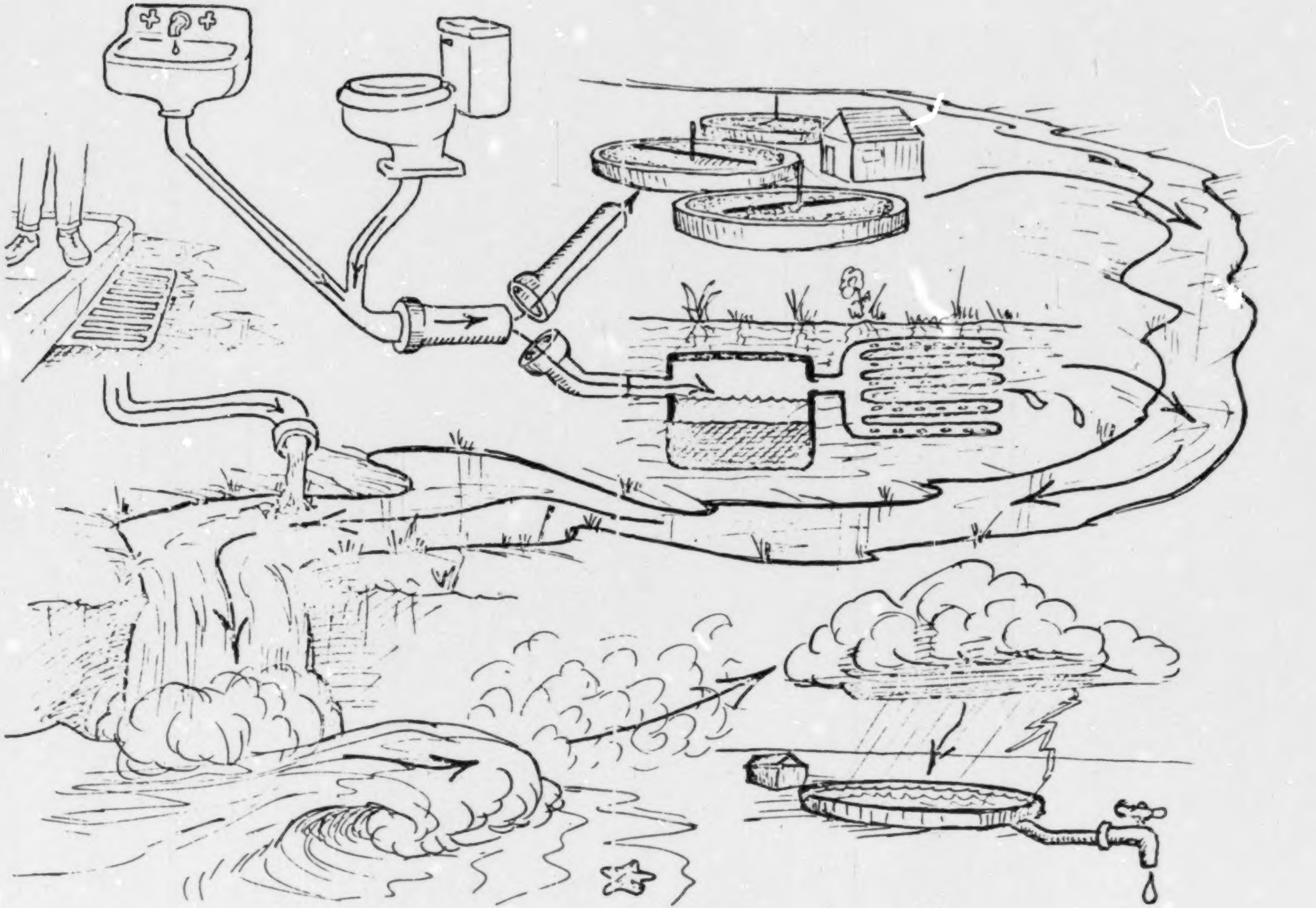
Have the children simply put on the chart the number of times they drink water during the day and the amount they drink each time they measure with their cup.

If a child drinks 4 times with the quantity each time being 4 ounces, 8 ounces, 3 ounces, and 5 ounces, then his average per drink is 5 ounces per drink. Let the children measure as many as they want, so long as they don't make a drinking contest out of it.

When each child has figured out the average amount of water he drinks, have him put this figure on his chart under average drink (A).

To figure the amount of water used for washing, have the child calculate how much water comes out of the faucet when he washes his hands one time. Do this by having a team of two, with one measuring at another sink while one washes. In other words, as Child A washes his hands, Child B runs the water in another sink for the same amount of time and measures it with his drinking cup. Figure an average for the whole class and have each child insert this figure in the average column for each day (A).

MASTER B-2



Accept as valid the average figure of 6 gal/flush for toilet use and avoid measuring, which may cause some sanitary problems. Have the children put 6 gallons in their Bathroom A column for each time.

Now all the children have to do for 3 days is count the number of times they take a drink of water, wash their hands, and go to the bathroom.

Put a mark down for each time, total them up, multiply to figure gallons, and average the days. This will give the amount of water for personal use per day.

TEACHER'S NOTE: It is very important to point out to the children that there were many things that were not included because it would be difficult to calculate them. These were such things as showers, baths, washing clothes, water contained in food and drink, and the water required to make products and grow food. The total amount of water used per day for every person in this country is estimated to be about 1,800 gallons. If this is hard to believe, the following facts and figures may be of interest:

It takes about:

300 gallons of water to make 1 gallon of beer.
10 gallons of water to refine 1 gallon of gasoline.
250 tons of water to make 1 ton of wood pulp.
325,800 gallons of water to raise 1 acre of alfalfa.
600 to 1,000 tons of water for each ton of coal burned in a steam power plant.

Therefore, it is very important that children become aware of their own personal effect on the use of this one resource, water.

ACTIVITY 2: Exploring Man's Effect on Water Quality

Discuss with the children what happens to water after it is used by us.

Prepare an overhead transparency from Master B-2, and ask the children, "What happens to the water after you use it?"

TEACHER'S NOTE: Cover each step of Master B-2 with a blank sheet of paper, if it is used as a transparency. Local situations will determine just how far one can go. In other words, Master B-2 starts with water going down the drain, from there it goes either directly into the soil (cesspool, filter pond), into a septic tank system, or into a community filtration system. Choose the one that is appropriate to your situation and discuss each step with the children.

The following questions may be helpful:

What happens to water after we use it? Where does it go?

(Show the children on the transparency that it goes either into the soil, into a septic system, or into a sewage treatment system. Choose the appropriate one and continue.)

How is waste water and sewage cleaned as it goes into the sewer or septic system?

TEACHER'S NOTE: Explain that there are very small animals, so small that they could not be seen with the naked eye but would have to be looked at through a microscope. These animals, called bacteria, live in treatment systems and actually eat the waste material in the dirty water and change this material back into harmless matter. After this, the water is filtered by having it run through a series of rock, sand, or soil filters that allow only clean water to pass through. It is very appropriate at this point to take the children on a field trip to a sewage treatment plant, if this is possible. If not, the following exercise may help the children to understand how water is treated after it is used.

ACTIVITY 3: Making a Filter System

Materials needed:

1 plastic milk bottle
A small bag of sand (enough to put 1-1/2" in bottom of bottle)
A small bag of aquarium gravel (enough to put 1-1/2" on top of sand)
A small bag of crushed stones about 1/4" across (enough for 1-1/2" on top of aquarium gravel)

Procedure:

a. Cut the top off of the milk bottle.

b. Punch holes about every inch or so around the bottom of the bottle.

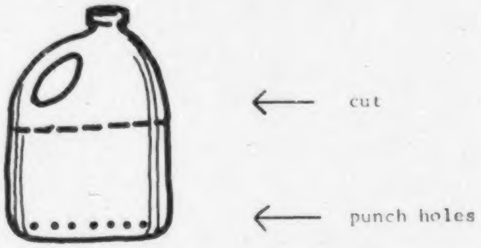


Figure B-3

c. Put in 1-1/2" of sand, 1-1/2" of aquarium gravel, and 1-1/2" of crushed stones (Figure B-4).

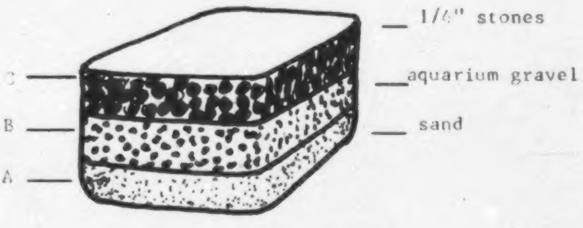


Figure B-4

d. Place the filter in a collecting pan (anything will serve that will hold the water once it has passed through the filter).

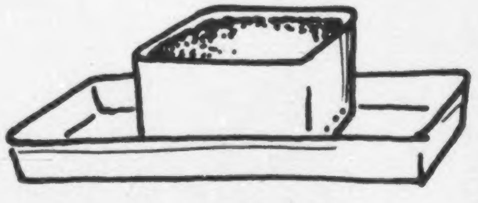


Figure B-5

e. Take a glass of water from the tap and put some dirt or soil in it. Stir until well mixed and pour slowly into the top of the filter. Repeat this until the water level in the filter reaches the top of the gravel and allow the water to seep slowly through the filter medium. It may be necessary to repunch the holes from time to time if the water does not flow.

Ask these questions:

What happened to the dirt that was in the water?

Would you be satisfied to have this water go back into a stream or river after filtration?

How much sand and gravel might it take to filter all of our waste water?

How much do you think it might cost to do this kind of treatment?

What would happen if we just dumped dirty water into our rivers and streams?

TEACHER'S NOTE: It is important to point out to the children that this is just one example of man's effect on one resource and that man has an effect on each resource he uses. These effects are usually quantitative and qualitative.

EVALUATION:

Given the opportunity to observe children using water, the teacher will note behavior that in her judgment indicates an awareness of wise use.

Given the opportunity to tell their teacher the amounts of water that they use during an average day, children will demonstrate that they have gained correct knowledge about their use of water.

Given the opportunity to tell what happens to water after it is used, children will demonstrate their knowledge of the fact that people make water dirty and must therefore clean it up after they use it. Knowledge about methods of filtration and water treatment will at this point depend on the teacher's judgment about the child's readiness to learn these concepts.

Given the opportunity to answer the question "In what two ways do people affect natural resources?" children will demonstrate by their answer that they know that people have both a quantitative and qualitative effect on water resources.

Section B

Topic V

USING RESOURCES WISELY

GOALS: After this lesson the children should:

Understand that all things must be considered resources and used in the most desirable ways.

Recognize the importance of wise natural resource use.

Become aware of some of the desirable ways they personally and directly use natural resources.

Begin to recognize some of the indirect ways in which they can help by being selective in choosing certain kinds of products.

ACTIVITY 1: Learning About Alternatives with a Story

Conservation means wise use and sometimes wise use means preservation. What do you think the word preservation means?

Tell the following story:

A little boy named Samuel was rummaging around in his grandmother's attic one day when he saw a very old trunk near a window. The trunk looked and even smelled very old. Struggling with the large leather belts and brass latches that held the lid down, he slowly raised the lid. The hinges on the trunk were so old and dry that they made an eerie, creaking sound as the top was opened.

As the dust cleared away and the light beams from the window settled on the contents of the trunk, Samuel saw something glitter very brightly: a medal with a beautiful ribbon attached to it. What a find! Samuel reached in and began to pick up the medal, but noticed that it was attached to what looked like an old gray piece of cloth. Not wanting to tear the cloth, Samuel decided to lift it out of the trunk to examine the medal closely.

Another surprise! The old gray cloth was really the coat of an Army officer; very heavy, very tough, coarse material with brass buttons and the division insignia on the collar.

Laying the coat aside for a moment, Samuel, now filled with anticipation, began to look and feel around in the trunk for what he hoped would be the rest of the uniform. A hat, boots, trousers, gloves with beautiful gauntlets attached; what tremendous luck! Samuel had found a complete Civil War officer's uniform. He was overjoyed and couldn't wait to run downstairs and ask his grandmother if he could have it.

"Grandma, Grandma, can I have it, can I have it?" Samuel shouted excitedly as he ran into the living room of the old house. "For Heaven's Sakes," Grandma said, "calm down. Can you have what?"

Samuel began to relate excitedly his find to his dear old grandmother, and as he did so, he noticed her eyes become cloudy and a look of sadness come over her face. "Have I done wrong, Grandma?" Samuel asked. "I thought it was all right to explore the attic." Her eyes clouded for a moment by memories of long ago, suddenly brightened and she said, "Oh, forgive me dear child, but your discovery reminded me again of something that was a very sad part of my life. You see, my father was a very brave and fine man, and when the Civil War broke out he joined the Army and was made an officer. We did not see him for over two years. Then one day a messenger came to the house in a horsedrawn carriage with the trunk you found upstairs and a sad message that my father had been killed in the Battle of the Monocacy, in the State of Maryland. The medal was awarded him for bravery."

Samuel felt very sad and confused because he did not know whether he had done right or not, but his grandmother made him feel better when she said with a smile, "So you want the uniform. Well, what do you intend to do with it?" This question was difficult for Samuel to answer because he really didn't know why he wanted the uniform. All he knew was that he felt he had to have it. Finally Samuel said, "I would like to take it to school and show my friends."

Grandma thought for a long time, remembering how much the uniform had meant to her family and at the same time, knowing how happy Samuel would be if he could show it to his friends in school. Being a typical grandmother, she finally said, "Certainly, you may take it to school and show your friends, but please be very careful because the material is old and must be treated gently or it may tear."

Grandma gave Samuel some cardboard boxes to pack the various parts of the uniform for their trip to school. He carefully packed each one.

Later that evening, Samuel's parents came to pick him up and help him carry his treasures out to the car. Just as they were taking out the last box Grandma shouted, "Hold on a minute. I think there is one more thing around here someplace that you may want to take along." Grandma walked over to an old chest of drawers in the parlor, and after rummaging around in the bottom drawer exclaimed, "Ah, here it is." When she returned, Samuel couldn't believe his eyes. There stood Grandma with a very real sword and scabbard. Grandma said, "I had almost forgotten this old sword, but I think it is a part of the uniform and should go along with it."

Monday morning Samuel and his dad took the uniform and sword to school and into Samuel's classroom. Mrs. Franklin, Samuel's teacher, was very pleased and assured him and his dad that the articles would be well taken care of.

Samuel could hardly wait until Mrs. Franklin decided to let him tell about his new find. Finally the big moment came, and Samuel shared the stories his grandmother had told him with his classmates while they looked over the old, old treasures.

After the class had the opportunity to touch and look at the uniform, Mrs. Franklin said, "Class, I have a question for you. We have been talking about the wise use of resources. What do you think might be the best use of this old uniform?"

The class suggested everything from putting it back into the trunk to letting each class member keep it for a week at a time to show their friends.

Mrs. Franklin reminded the class that when they discussed the word "conservation" they decided that it meant the wise use of resources. She then asked, "What could be done with the resource (the uniform) that would benefit the most people? We could find someone who needed clothing and give it to them to wear. Would this really be a good idea, or might it be best, in this case, to preserve the resource? Preservation would mean that we would put the uniform in a museum so that many people can share it and find out what a real Civil War uniform looks like."

The class was unanimous in their decision that, in this case, preservation would be best, but someone mentioned it didn't really matter what they thought best because the uniform wasn't theirs anyway.

That afternoon when Samuel's dad came to pick him up at the school, Mrs. Franklin mentioned her discussion with the class and the decision that they had made regarding the best use of the resource. His dad thought that the idea was a very good one, and said he would ask his mother, Samuel's grandmother, what she thought.

The happy ending to the story is that Samuel's grandmother was very happy to see the uniform put in the local history museum where it can be seen by hundreds of people. This is an example of both conservation and preservation.

ACTIVITY 2: Finding Other Things to Preserve

What other things might we want to save in our community?

Take the children on a short walk outside the school building and try to find some natural resources that may have more than one use. For example, any tree in the area could be either left alone for its shade and beauty, or cut down and used for paper, wood, or any of the other wood products. What would they decide?

In situations where there is open space around the school, ask the children what they think the best use of the open space might be. Should they plant food on it, play on it, put buildings on it, or what?

ACTIVITY 3: Making Decisions

As a homework assignment have the children look for, on the way to and from school, five things they feel are not being used wisely. Remind the children that they may consider both natural and man made resources because man made resources are really most natural resources in a different form.

The following list of suggestions may help children to discover some things that are not being used wisely:

Urban:

Park and playgrounds with litter on them.
Junk cars sitting on the street.
Buses and cars going by with very few people in them.
Words on buildings and walls.
Space, vacant lots, and stores.
Manpower not being used.

Rural:

Poor use of soil.
Use of rivers and streams for dumping sewage.
Fields taken over by weeds.
Plants being destroyed by insects.

Both Urban and Rural:

Poor decisions in the use of time, money, paper, cars, food and water, and air.

When the children bring in their lists, have them discuss why they think these things are being used wrong, and help them to come up with possible solutions to the problems.

ACTIVITY 4: Understanding the Relationship Between Values and Use

Pose this problem to the children. If you were on an island that had no food, no trees, and no fresh water, and an airplane flew over that could either drop you a package with food and water enough to last until you were rescued, or a package containing a million dollars, which would you choose and why?

Point out to the children that the use of resources always has and always will depend upon how much value is placed upon them. In the case above, a person's value system would change if he realized that a million dollars wouldn't be any good at all as compared to food and water. Ask the following questions:

How could we apply this principle to some of our environmental problems?

If water fountains had a coin slot on them and we had to pay for each drink we took, would we drink as much water?

Suppose all soda pop cans and bottles were worth 25 cents. Would we see so many of them lying on the ground and thrown away?

TEACHER'S NOTE: Help the children to discover that natural resources really do cost something and that they must be taken care of. They could not only cost more money but also affect the ability of people to live on this planet.

ACTIVITY 5: Relating Use Decisions to Everyday Situations

Have the children consider the following situation: You have been sent to the store by your mom to buy the following things:

milk, cola, washing powder, candy bars, some picnic plates and cups, and enough hot dogs for 10 people to eat.

How are you going to answer the following questions?

Milk comes in paper, plastic, and glass containers. From the natural resources point of view, which one would be best to buy?

Cola comes in glass bottles that are returnable, glass bottles that are non-returnable and aluminum cans. Which is the best environmental buy?

Washing powder comes in many varieties, some of which do a very good job cleaning our clothers but pollute the streams, while others don't get our clothes as clean but don't pollute the stream. Which should we buy?

Candy bars come wrapped in paper, plastic, and tinfoil. Which should you buy?

Picnic plates and cups come in plastic and paper. Which should you buy?

Hot dogs come in packages of 12. You have 10 people who may want 2 hot dogs each. Should you buy 1 package and have 2 people get 1 hot dog or should you buy 2 packages and have 4 hot dogs left over?

The above exercise is designed to help the children to see what might be called the indirect ways that they affect the use of natural resources. Take this opportunity to reinforce the concept that all man made products are really natural resources in another form.

ACTIVITY 6: Exploring the Cost of Natural Resource Use

Poor use of natural resources not only affects one's eventual health and welfare but it also affects economic situations. The economic effect is immediate and day-to-day, and must be explored to have a complete understanding of environmental problems.

Have the children consider the following questions:

Ten ounces of soda pop costs 5 cents before it is in a container. A 10-ounce glass bottle costs 5 cents. A 10-ounce steel can costs 6 cents. A 10-ounce aluminum can costs 7 cents. Which of the soda pop containers would you buy if you wanted to make the best use of your money and of the natural resources used to make the container?

There are two bus companies in your town. Bus company A has decided to put anti-pollution devices on all of its buses while bus company B has decided to keep its buses running the same way they are now. A ride across town on company A's bus will cost 5 cents more (because of the anti-pollution device) than the same ride on company B's bus. Which of the companies would you ride with and why?

By cutting down on the cost of litter removal in a park in your town, the Park Department can have enough money to pay for an extra set of swings and eventually a new baseball field. Would this be the best way to use their money? What might be other solutions to the problem that would keep the park clean and also have the swings and ball fields?

The street in front of your house is in very bad shape because of holes and ruts. The man in your town who is in charge of streets comes by and says that they are going to be able to fix the street but it will mean they will have to stop picking up garbage for 6 months. Would you like to see this happen?

There is a very nice park in your town, but taxes are very high and everyone is complaining about this problem. Election time comes around and one of the men running for mayor says that if they sell the park to a man who will build apartments, there will be more people in a small space and they can get a very high price for the park land so taxes can be reduced. Do you think that you would vote for this man if you could vote?

Mr. Jones owns a candy store and wraps all of his candy in plastic to keep it fresh. Mr. Smith also owns a candy store but he goes to his supplier every day to buy fresh candy and does not wrap it in plastic. Mr. Smith has to charge a little more money for his candy because he has to make more trips to get it to his store. Which store would be the better place to buy candy, from a resources point-of-view?

TEACHER'S NOTE: The above questions are designed to help children realize that environmental improvement is often a matter of "trade offs." In the question about the buses, for example, people must pay a little more if they are going to help clean up the air. The point to be made here is that improving the uses of our natural resources can only be accomplished if the public is willing to pay for it.

EVALUATION:

Given the opportunity to explain what wise use of resources is, children will demonstrate their knowledge of the fact that sometimes it means to preserve or keep and sometimes it means to use very carefully.

Given the opportunity to observe their community for the purpose of determining areas where things were being used unwisely, children will be able to demonstrate their understanding by the things that they select.

When Activity 4 is finished and the questions are being answered and discussed, children will indicate that they have a concept of how their selection and buying of products affects the environment.

Given the opportunity to see the children purchase something that had a natural resource relationship such as plastic or paper plates, the teacher would see the child choose the one that demonstrated a natural resource value system being developed in the child.

Given the opportunity to observe the children use resources (pencils, paper, water, etc.) the teacher will notice a reduction in the amount of things they waste that is a significant indication of an additional change on the part of the children.

Section B Topic VI

RENEWABLE NATURAL RESOURCES

GOALS: After this lesson children should:

Identify the renewable natural resources as air, water, soil, plants, and animals.

Understand the importance of natural processes such as decomposition to the eventual renewal of natural resources.

Understand that the renewal of natural resources is an interdependent situation. All natural resources that are renewable depend upon other natural resources to be renewed.

Have had the opportunity to observe natural change that is related to natural resource renewal and to see man's effect on renewable natural resources.

ACTIVITY 1: Learning the Meaning of Renew

Ask children to think of some words that begin with the prefix "re."

As the children come up with such words as refill, rebuild, restore, renew, recycle, retain, and recreation, put them on the board and point out to them that the prefix "re" usually means "to do again." Ask them to keep this in mind and to tell what the words on the board mean. Emphasize the word renew and be sure the children understand that it means to make new again.

ACTIVITY 2: Learning the Meaning of "Decompose"

Ask the children to consider the meaning of the word "compose," To compose, of course, is to make. If the children compose a song or a poem, they have put words together and made something. Now have the children recall their experience with adding the prefix "re" to a word and changing the word. Ask them how the meaning of the word compose would change if the prefix "de" were added to it, making the word "decompose." It would then mean "to break down."

"Decompose" is the first step toward remaking some of our resources. If these resources are not broken down they cannot be made new again or renewed.

ACTIVITY 3: Finding Evidence of Decomposition

Take the children on a short walk around the school building and ask them to look for evidence of breakdown or decomposition. The following examples should help: metal rails showing signs of rusting, paint chipping, wood rotting, stones and bricks crumbling or gradually wearing away, sidewalks, roads, parking lots cracking and beginning to break down, and dead plant or animal material returning to soil components.

Have the children list and possibly sketch some of the things that they observe breaking down or decomposing.

TEACHER'S NOTE: Odor is sometimes a good indicator of breakdown. Encourage the children to be alert to the things they smell and to try to seek some of these things out. Garbage cans, barnyards, dumps, compost piles, all have distinct odors. This is a very good chance to point out to the children that they smell things in the air just as they taste things in their mouths. Have the children add to their list of things those that they smell.

Should children need more direction in this exploration, teachers may want to make a scavenger hunt out of it. This is simply done by locating the things and putting them on a list and letting the children hunt for them.

Encourage the children to keep looking for evidence of breakdown and decomposition as they go to and from school.

As the children begin to build a list of observations of breakdown, and you feel that they are beginning to understand the concept, start to emphasize the fact that breakdown and decomposition often come before rebuilding or renewal.

ACTIVITY 4: Exploring the Relationship of Breakdown to Buildup

TEACHER'S NOTE: Help children to understand the basic structure or composition of some of the things that make up their world. The children will have to be aware of the endpoint of breakdown in order to understand the relationship of breakdown to building. The endpoint of most decomposition would be an *atom* or *molecule*.

When a person eats food the first thing that he does is break it down into smaller parts so that it can be swallowed. As the food is chewed it is also mixed with saliva which contains a chemical that aids in the breakdown of food. When the food moves into the digestive systems it is further mashed by the muscles in the stomach and intestine and mixed with chemicals, releasing the proteins, vitamins, carbohydrates, fats. Discuss this process with the children and help them to understand how food breakdown and body buildup are related and how this same breakdown-building relationship happens when many things are renewed.

Let the children take some materials apart and see how small a piece of material they can physically break down. Some good materials for this are chalk, graphite from pencils, strands of string, cotton, material from clothing, paper and soft pieces of wood.

The point to make here is that the first process that occurs in breakdown or decomposition is usually *physical*. Things change in size and shape, but they do not change in actual composition until they are acted on by chemicals or bacteria. A change in composition is called a chemical change. The changes that take place in decomposition are often both *physical* and *chemical* in nature. Help the children understand that before something can be renewed it must be broken down into its component parts. It is very much like a picture puzzle with nature taking it apart and putting it back together.

A good way to demonstrate chemical change is to put a nail in a jar of water and watch the rust form on it. You are actually seeing the result of oxygen combining with the iron to form ferrous oxide or rust. Ferrous oxide is usually the raw material found in iron ore from which steel is made. Given enough time nature may be able to turn steel back into iron ore by the process of decomposition.

TEACHER'S NOTE: The breakdown of certain materials can really be turned around and looked at as the buildup of something else. For example, the decomposition of leaves and plant material is really the building up of soil. Look for opportunities to help children understand the importance of death, decay, and decomposition to the overall renewal of our material resources. All material cycles through the environment, some of it very quickly (water, for example) and some very slowly (iron, for example).

ACTIVITY 5: Studying Soil as a Renewable Natural Resource

The following experiment and demonstration will give the children the opportunity to see just how a soil will renew itself. Start the experiment soon so that the children will be able to observe it for as long as possible.

Materials needed:

2 small (1 cup) containers
bean seeds

Procedure:

In the two small containers, put equal amounts of soil and one bean seed. Number the cups 1 and 2. As the bean plants grow to a height of about 6 inches, do the following: Remove the plant from cup 1. Throw it away and plant another seed. (Do not remove any soil with this plant.) Remove the plant from cup 2 and have the children cut it up into very small pieces. Mix these with the soil in cup 2 and plant another bean seed into the cup.

TEACHER'S NOTE: Keep the above experiment going for as long as it takes to have the children see that the soil in cup 1 is being used and not renewed, while the soil in cup 2 is also being used, but through decomposition it is being renewed and can be used over.

ACTIVITY 6: Studying Air as a Renewable Natural Resource

Air is a natural resource that is made up of oxygen, carbon dioxide, water vapor and other gases. Carbon dioxide and oxygen are the two components of air that are most important for plant and animal respiration or breathing. Animals breathe in air and use the oxygen in it, and breathe out carbon dioxide (which is the waste product of metabolism or muscular activity). Ask the following questions:

What would happen to the air if animals were the only living things?

They would use up all the oxygen and it would be replaced with carbon dioxide.

Without oxygen what would happen to animal life on the earth?

How is the oxygen used by animals replaced?

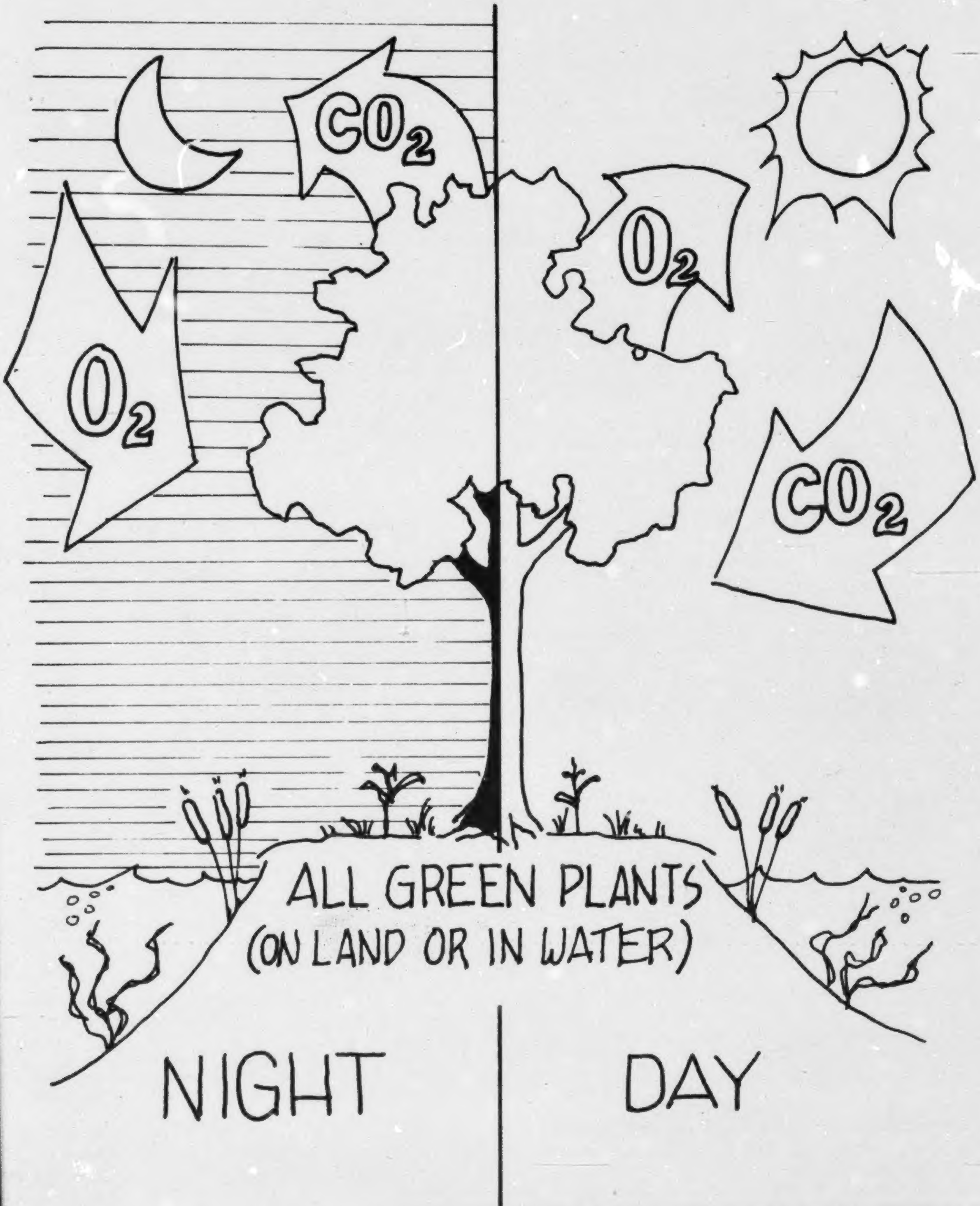
Master B-3 may be prepared as an overhead transparency to explain the following:

In the presence of sunlight, plants take in carbon dioxide and give off oxygen.

TEACHER'S NOTE: You may be interested to know now this takes place. The following formula will help explain it to you:

$$6\,CO_2 + 6\,H_2O \xrightarrow[\text{Chlorophyl}]{\text{Sunlight}} C_6H_{12}O_6 + 6\,O_2$$

MASTER B-3


CO_2
O_2
O_2
CO_2
ALL GREEN PLANTS
(ON LAND OR IN WATER)
NIGHT
DAY

The basic formula for sugar is $C_6H_{12}O_6$. The verbal explanation would go like this: In the presence of sunlight and chlorophyl, a plant breathes in carbon dioxide, combines it with water and makes sugar. This causes some oxygen (O_2) to be left over and it is given off or breathed out.

As the sun goes down and the plant is deprived of light it gives off CO_2 and takes in oxygen just like an animal does.

The interesting and important thing to note is that animals are totally dependent upon plants for air that has been renewed. Plants could survive without animals because they release more oxygen into the air in the daytime that they use during the night.

TEACHER'S NOTE: There are, of course, other things in the air besides CO_2 and O_2. These two components are used for explanatory purposes because they are so important to the respiration of plants and animals, and their absence would be noticed more quickly than would some of the other components. There is an excellent opportunity here to emphasize the reality and importance of interdependence. Even though the quantities of CO_2 and O_2 remain constant they require the interaction of plants and animals to be used wisely and be renewed.

ACTIVITY 7: Studying Animals and Plants as Renewable Natural Resources

Animal and plant species are renewable natural resources. They renew themselves through the processes of *reproduction* and *growth.*

TEACHER'S NOTE: This is an excellent time to introduce the words and concepts associated with reproduction and sex education. The teacher's judgment will be the factor in determining what is or is not appropriate at this point.

The following dialogue is a sample of how these concepts might be introduced:

> We have talked many times about things that are alike and things that are different. Can you tell me how you are different from each other?
>
> What two study groups could we put everyone in our class into? (Boys and girls.)
>
> There is a very important reason for our being sexually different from each other and for most animals and plants to be different sexes. Men and women or males and females are able to reproduce themselves.
>
> What does the word reproduce mean?
>
> Remember when we discussed words that began with the prefix "re" and we said that "re" meant to do again? Well, if "produce" means to make and "re" means to do something again, then what would reproduce mean if we were talking about making people or animals, or plants?
>
> How are the words reproduce and renew related?
>
> Reproduction is simply the way plants and animals renew themselves.

TEACHER'S NOTE: The important concept from the natural resource standpoint is that sexual reproduction is the way most plants and animals are renewed, and that this renewal depends upon other natural processes for support.

ACTIVITY 8: Exploring Mans Effect on the Renewable Natural Resource: Trees

TEACHER'S NOTE: Our effort here will be to help children to understand that man affects renewable natural resources in two major ways: (1) he uses them faster than nature can renew them; (2) he makes air and water very dirty and must clean them before they can be renewed.

The rate we use natural resources.

Have the children consider the following problems:

> It takes about 50 years to grow a tree that is large enoug be cut down and sawed into lumber for houses, furnit and other things. John Jones and his family use 4 trees year from a woodlot with 200 trees on it. The oldest tree the woodlot are about 50 years old and the youngest starting out. There is a fairly equal number of trees in e age group.
>
> Using the information in the paragraph above, can answer the following questions:
>
>> If John and his son cut down the 4 oldest trees each and do not replace them, how many years will they trees to use?
>>
>> Someone down the road wants to buy 4 trees per from John. How long could they have trees to use if t started cutting down 8 trees a year, assuming that t replaced the 8 trees with new ones?

TEACHER'S NOTE: This little math exercise is designed to s the children that a resource is renewable only if it is used at same rate that it renews itself. For example, the forest will re itself every year if trees are used at the rate of 4 per year bec 200/4 = 50 years and it takes 50 years for the new trees to gr If, however, the rate of use increases to 8 trees per y 200/8 = 25, after the first 25 years there would be no more t that were old enough to be cut down. In other words, the 8 t that were planted the first year would be only 25 years old would be the oldest trees in the forest. This kind of exercise ma made more or less difficult. The point to make is, that man must renewable natural resources only at the same rate that they renewed, or he will use them up.

ACTIVITY 9: Exploring Man's Effect on the Renewable Nat Resource: Air

Review the CO_2 - O_2 cycle with the children as well as process of respiration and the need for clean air. Then do on all of the following to demonstrate how man makes air dirty:

> Start a car.
>
> Take a white handkerchief or a large wad of cotton and h it over the exhaust for just a few seconds.
>
> Have the children observe the results.
>
> Pass it around and have them smell and feel the residue the handkerchief.
>
> Ask the children where the material goes if there is handkerchief to catch it.

Discuss this problem with the children and point out to th that when they breathe air that has the solid or particul matter in it, our lungs have to filter it out just like handkerchief did.

Have the children bring in newspaper articles and help th relate what they saw on the handkerchief to the overall probl of renewable air.

Take the children on a walk around the school building and h them note all the sources of air pollution that they can se smell.

Cover a 3 x 5 card on both sides with masking tape so that sticky side is out. Have each child place a card on a partic spot on the school ground and note the direction the win blowing. Place the card so that one side is into the wind. card should be mounted on a small stick. See Figure B-6 be

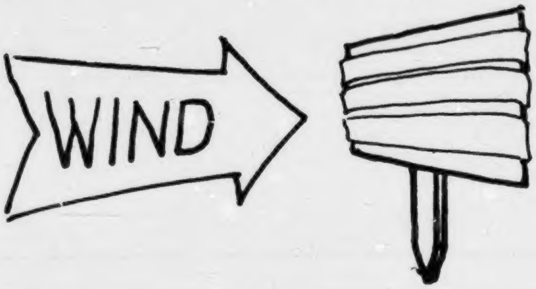


Figure B-6

Have the children observe their cards for two or three days and then bring the cards into the classroom and discuss the results.

EVALUATION:

When asked to identify those resources that are considered renewable, children will identify either verbally or in writing – air, water, soil, plants, and animals.

When asked to define the words "renew" and "decompose," the children will indicate by their answers that they understand that to renew means to make again and to decompose means to break down.

When asked to give some examples of decomposition, the children will indicate that they did understand the meaning of the word and can identify those examples of it that were observed in Activity 2.

When asked to identify the two ways things change, children will respond by saying physically and chemically, and if given the opportunity to recognize change that is either one or the other, the children will correctly identify the type of change observed.

Given the opportunity to explain the way soil, air, or water renew themselves, children will indicate a basic understanding of these processes.

Given the opportunity to discuss the way man affects renewable natural resources, children will indicate by their comments that they understand that man sometimes uses natural resources faster than they can be renewed and sometimes makes renewable natural resources dirty so they are not as easily renewed as they could be.

Section B Topic VII

NON-RENEWABLE NATURAL RESOURCES

GOALS: After this lesson children should:

Be aware of the fact that some resources are exhaustible and will run out.

Have learned that the non-renewable natural resources are minerals and mineral fuels.

Understand the difference between renew and recycle.

Understand that mineral fuels are non-renewable or exhaustible because they are used much faster than they can be replaced by nature.

Understand that minerals are exhaustible because there is only a certain amount of each of them available.

ACTIVITY 1: Comparing Renewable and Non-Renewable

The following demonstration will enable children to understand the concepts of renewable and non-renewable.

Materials needed:

3 1 lb coffee can
2 1 qt jars

Procedure:

a. Punch one small hole in the bottom center of each can.
b. Place two cans over the two jars, open end up, and fill them with water.
c. Water in can C should be colored with food coloring.
d. Place the third can (C) over the top of can A and fill it with water. See Figure B-7.

Tell the children only this; that the water in cans A and C represents all the water in the world, while the fluid in can B represents all of the fuel oil in the world. (Do not worry about any definite quantity at this time. Each amount represents all there is.)

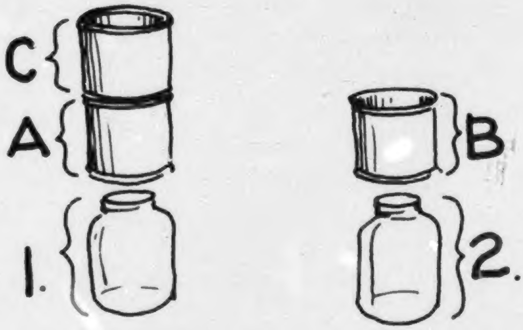


Figure B-7

Cans A and B represent the use we make of the natural resources, water and gasoline (or oil or fuel). The hole in the bottom of each can represents the rate at which we use the resource.

Can C represents the resource (water) being renewed at the same rate it is being used, (one drop used – one drop renewed).

As jar number 1 starts to fill up, "recycle" it by simply pouring it back into can C. As jar number 2 starts to fill up, "burn" it by pouring it down the drain. As this is done, explain to the children that once a fuel is used it is no more – it is non-renewable.

As the demonstration proceeds, ask the children these questions:

Which of the resources will run out and which one will not?

If we could not find a replacement for the fuel oil in can B, what might we consider until one was found?

At this point, dramatize this point by simply plugging the hole in the can with a finger. This will demonstrate a decrease in the rate of use.

> If we were to decrease the rate at which we use fuel oil today, remembering that fuel oil is also gasoline and jet fuel (kerosene), what would it mean to us?

We would have to walk more, ride less.

> What are some ways that we might slow down the use of fuel oils?

Point out this fact to your children as they watch the fluid in can B go down the drain: most resources that are truly non-renewable are the ones we use for energy. These materials are often referred to as mineral fuels which includes the fossil fuels such as coal, oil, and gas.

ACTIVITY 2: Exploring the Non-Renewable Resource Fuel

TEACHER'S NOTE: The fact that it took 70 to 100 million years to make the coal that is now being used only means something to someone who can conceive 70 to 100 million. Children are not able to do this, nor are most adults. The following two concepts are the important points to make: (1) energy fuels were made over a very, very long period of time; (2) when they are used, they are used up very quickly. Fuel is used much faster than it is made.

Most of the fuel is called fossil fuel. All *fossil fuel* comes from energy that was stored in plants and animals and took a long time to be formed into the coal, gas, and oil that is found today.

It would be very helpful to take the children on a fossil hunt if there are areas near the school where this might be possible. Call the science coordinator and ask where fossils might be found. If there are none in the vicinity of the school, ask him to help to obtain some examples of fossils and ask the following questions:

> What is a fossil?
>
> Were all fossils either plants or animals?
>
> Were all fossils once alive?
>
> How old are some of the fossils?
>
> How did nature turn plants and animals into fuel?

The following demonstration will help the children to see how gas was formed:

> In a small bottle with a small neck (a soda pop bottle will do nicely if it is not colored) place a small amount of hamburger and lettuce leaves. Put a small balloon over the the bottle mouth and place it in a spot where the sunshine will hit it. Leave it for as long as it takes for the balloon to start to fill with gas.

TEACHER'S NOTE: The hamburger represents an animal that has died, the lettuce represents a dead plant, and the bottle is just a place to observe what happens.

As the plant and animal material begin to decay, gas will be given off and trapped in the balloon.

As the children observe this ask them the following questions:

> We have observed decomposition on our school grounds and know that it makes soil. What would happen to the soil as many, many layers formed and the bottom layer was under tremendous pressure? Would it get harder or softer?

Master B-4 may be prepared as an overhead transparency or you may duplicate it and pass it out to each child. This and the following explanation may help the children understand how mineral or fossil fuels were formed.

Frame 1: Many, many years ago, before man appeared on earth, there were large areas of swampland that looked something like the one in Frame 1 of the sheet/transparency.

Frame 2: In this picture some of the plants have died and fallen into and under the water. Do you think a plant that is under water would decompose/rot as fast as one that is exposed to the air? The answer is that it would *not*, because decomposition requires oxygen and when the water covers the plants, they decompose very slowly. This means that the energy that they have stored up from the sun is trapped and stays there.

Frame 3: As the years passed, plants continued to die and pile up, and a strange thing occurred: The weather all over the world became warmer and the ice in the north and south polar regions melted, causing the sea to rise, and the seas came in and covered the swamplands.

Frame 4: The oceans are filled with many small animals and plants called ***plankton***. During the long period of time that the oceans covered the swamplands, these animals died and fell to the bottom. This caused a great deal of pressure to be put on the original plants shown in Frames 1 and 2. These plants began to get very hard.

Frame 5: After many years the temperature of the earth began to get cooler. Ice started to form at the north and south poles. The ice took up a great deal of this water and the sea moved back away from the swamplands, leaving a thick coating of mud. This same thing happened many, many times, and each time the older layers were put under pressure, the following things happened:

Frame 6: The fat from the bodies of the ocean animals that died was squeezed out and began to drain down through the rocks below. The original plants continued to get harder and harder, and so did the mud that was left after the sea went back each time.

Frame 7: As the rocks got harder and harder, the earth's crust began to fold causing some of the layers to form little domes like the one seen in the picture. This made a perfect collecting place for the oil that was draining down from above, and this is where it is often found today.

Frame 8: The final picture we see is very much like the situation that exists today. The very old layers of plants have turned to coal and animals have turned to oil, which has collected in pools underground. All of this took some 70 to 100 million years. Does this tell us anything about how fast we should use our oil and coal, and why we consider these resources non-renewable?

ACTIVITY 3: Exploring the Non-Renewable Resource Metals

The children have seen what happens to a steel nail that is made from iron if it is exposed to the weather. Oxygen combines with the iron and turns it back into iron oxide. Man usually prevents this, however, by painting and coating the metal so that it will not rust. Have the children consider the following questions:

> What will happen if we keep producing automobiles that are made of steel, using iron from the earth? If we keep doing this at a faster rate than the iron rusts and returns to the earth, then what is eventually going to happen? Will we run out of iron and not be able to make steel, which would mean that we will not have steel to make any of the following: cars, trucks, railroad tracks, spoons, bicycles? What is the answer to this problem?

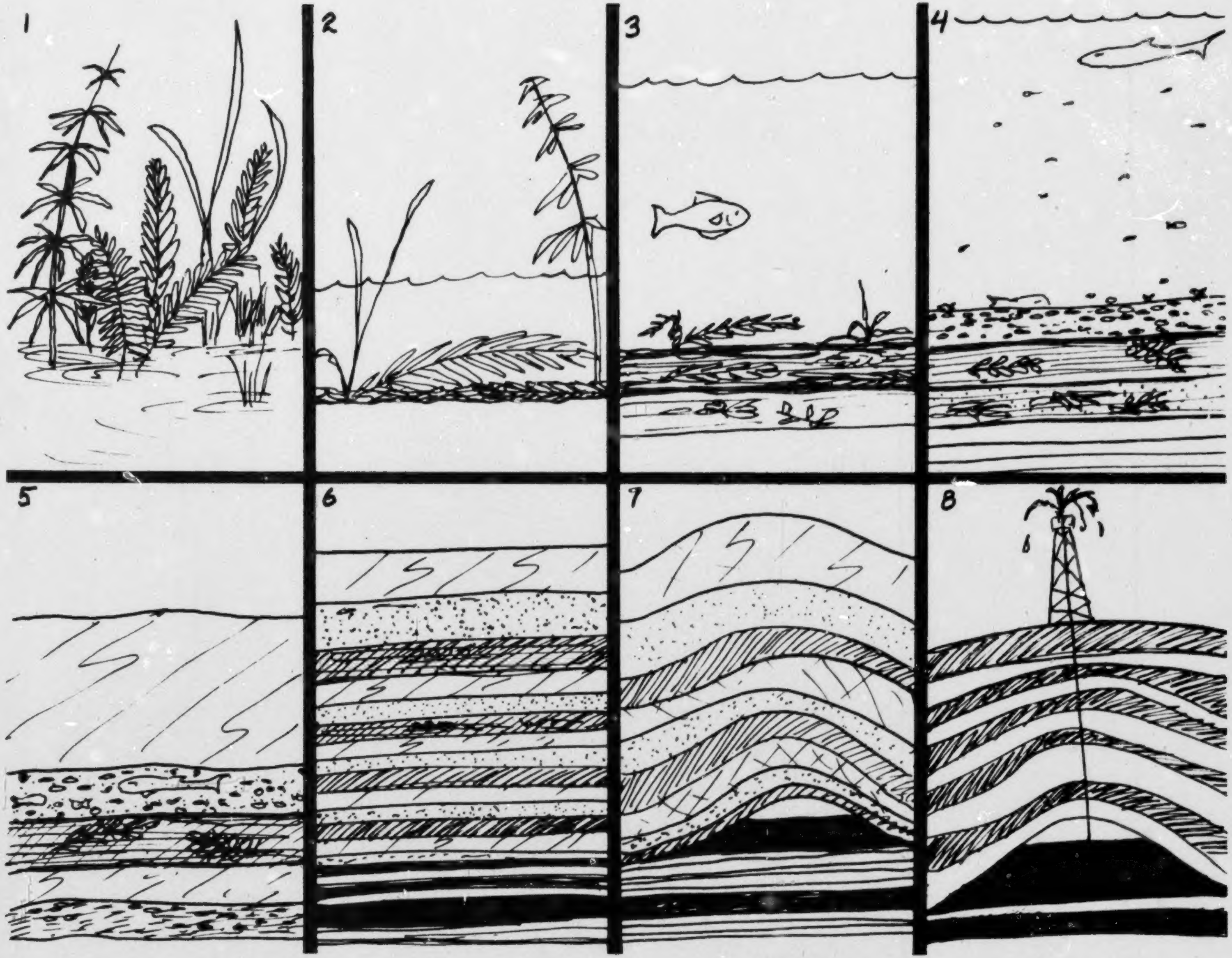
The metal already taken from the earth must be recycled, and not so much of the original iron ore should be used.

Discuss the word "recycle" again with the children and point out to them that once we take something from the earth, it will have to be used over and over again.

EVALUATION:

Given the opportunity to tell why any resource is considered non-renewable, the children will indicate to the satisfaction of the teacher that they understand the concept of rate of use versus the rate of production of natural resources.

MASTER B-4



Given the opportunity to tell which groups of resources are considered non-renewable, children will say "minerals and mineral fuels."

Given the opportunity to discuss the difference betwee "renew" and "recycle," the children will indicate by the comments that the understand that "renewal" means to remak in nature and "recycle" means to reuse again.

Section B PEOPLE WHO TAKE CARE OF NATURAL RESOURCES Topic VII

GOALS: After this lesson children should:

Be aware of the fact that, because of the tremendous rate of natural resources relative to needs, they must be managed, protected, and studied.

Be aware of the kinds of jobs that are available in the field of natural resources.

Be aware of the skills and knowledge that natural resource occupations require.

TEACHER'S NOTE: The information that follows is in narrative form and designed to be used with the list of activities. Teachers are encouraged to select one or several of the activities and help children to become aware of the various opportunities for employment that exist in the field of natural resources.

ACTIVITY 1: Have the children develop a bulletin of pictures of people working with natural resources and share the information below with each other and with other classes in the school. Pictures may be found in general publications as well as sports and outdoor publications.

ACTIVITY 2: Get in touch with local natural resource agencies that may provide resource persons to come and speak to the class.

ACTIVITY 3: Look into the field trip possibilities that may exist in the vicinity of the school that would allow children to meet people working in natural resource areas. Water treatment plants, fish hatcheries, zoos, parks, and municipal planning offices all offer field trip possibilities where children may meet a natural resource worker.

INFORMATION ABOUT PEOPLE WHO WORK WITH WILDLIFE

The people who work with animals can be divided into two study groups, those who work with *wild animals*, and those who work with *domestic animals*. The following are examples of some of the occupations in the wild animal category.

Wildlife Biologist

The wildlife biologist works in the area of wild animal study, making observations and experimenting with animals (to find out what they need to eat, how they find protection, what their relationship is to each other and to the plants in their surroundings, etc.) and keeping careful check on the animals' general health and welfare.

Most of the people who work as wildlife biologists are graduates of a four-year college program. They spend a great deal of their time in the out-of-doors, observing animals and studying animal environment. They also spend many hours indoors using mathematics, science, and language skills to record the evidence.

Game Warden

Many years ago when there were fewer men and more wolves, mountain lions and coyotes, man hunted only because he wanted food. As the years went by, the number of people increased, the number of predators decreased and the natural balance of nature was disturbed. Animal populations that were once small and in balance with the available food began to g very large. There was not enough food to go around an although many animals were born, very few of them reache maturity. Those that lived were in very poor health because of lack of food. Man, the hunter, has replaced the predator i many cases. Hunting, however, must be controlled and this where the game warden comes in.

The game warden is a combination of policeman, teache scientist, and veterinarian. Laws established by local, state an federal governments are designed to protect wild animals. Th game protector must enforce these laws. Observation of anim habitat and population numbers is another of the duties, as we as frequently assisting the wildlife biologist by collecting neede information about certain wild animals in an area.

A major duty of most game wardens is to teach people to hu safely and to enforce the hunting laws that exist.

A game warden must have a least a high school degree ar usually specialized training by the employing agency. Game law law enforcement techniques, public relations, game biolog natural history, outdoor craftsmanship, and the ability to g along well with people are all skills that a game warden mu have.

Game Farm or Refuge Manager

There are certain areas in many states that are managed for th express purpose of providing the proper habitat for wild animal Each of these areas requires a game farm or refuge manage depending upon what the area is called.

The game farm or refuge manager is in some ways similar to farmer who grows domestic crops and animals. Knowledge c what the animals need in the way of food and protection i required.

Game farm and refuge managers must know soils, crops, anima habits, and needs as well as farming and land use techniques. Th occupation requires at least a high school education and ver often experience and/or additional post high school technic training.

INFORMATION ABOUT PEOPLE WHO WORK WITH WATE AND FISH

Waterways Patrolman

Fishing is a very important sport in this country. So man people fish that it is necessary to allow fishing only durin certain times of the year for certain species of fish, and to lim the number caught on any one day. The waterways patrolma enforces these laws and serves the same role for fish as the gam protector serves for wild land animals.

Waterways patrolman also are responsible for checking on th safety of boats for recreation. They teach people how to u boats and fishing equipment properly, investigate sources c water pollution, and generally perform any duty that has to d with the protection of streams, rivers, and lakes, and the fi that live in them.

Water Quality Tester

There is a great deal of water pollution in our country today.

The water quality tester works with water in rivers, streams, and lakes, or might work for city government and test the water that is to be used by the people in the city.

People who work with water quality spend much of their time in the out-of-doors collecting samples from water sources and an equal amount of time in the chemistry laboratory testing the water to determine its quality.

Most of those people have at least two years of college and many of them hold college degrees. They must understand chemistry and biology and the methods used to get accurate samples from the water thay they want to test.

INFORMATION ABOUT PEOPLE WHO WORK WITH PLANTS

There are many occupations that have to do with plants. This material will cover three; the forester, the crop farmer and the nurseryman.

Forester

The modern forester is really a farmer. He takes care of large areas covered with trees, and must decide which trees to cut down, which trees to leave standing, where to plant new trees, and how to get the trees out of the forest without damaging more of the area than is necessary.

Skills needed in forestry include knowing how to use everything from axes to saws to very heavy power equipment such as bulldozers and trucks. Sometimes foresters need to know how to fly and parachute to forest fire areas that cannot be reached by a land vehicle.

The kinds of knowledge that a forester must have are very broad, including economics, mathematics, weather prediction, fire control, soil science, equipment use and maintenance, and many other things. It would be unusual for any one forester to be an expert in all of the fields. The amount of knowledge a forester may need in a particular area will depend upon particular forest specialties.

Most foresters have either two-year or four-year degrees with a specialization in one of the areas of forestry.

Farmer (Crop)

One farmer in this country raises enough food to feed himself and 48 other people. Farmers raise crops that are either fed to animals to produce meat and milk products or sold as produce.

Most farmers today are specialists. They grow a single crop. and must know not only general principles of farming, soil science, fertilization, weather, irrigation, equipment use and maintenance, marketing and economics. but also the specific principles that are relevant to the crop or crops that they are raising.

Farms today are much larger than they used to be. This makes it very difficult for a young person who does not already live on a farm to decide to become a farmer, purchase the land and equipment, and get started. Most farmers today are persons who were born and raised on a farm and inherit the business from their family.

Nurseryman

A nurseryman grows plants that are to be replanted later, usually sold to people to use around their homes and gardens, or to landscape gardners to use around buildings, streets, and highways.

Plants that are raised from seeds require very special care because they are easily damaged by disease or improper conditions. The nurseryman must be aware of proper conditions for raising young plants. Knowing when young plants are ready to be sold and how to take good care of them when they are moved from one place to another is also necessary.

Running a nursery also requires a knowledge of good business practices, equipment use and maintenance, weather, soil and farm management.

Many nurserymen are college graduates with degrees in horticulture, plant science, or some other phase of nursery crop production. There are also job opportunities for the graduate of two-year colleges and technical schools.

PEOPLE WHO WORK WITH MINERAL AND MINERAL FUELS

Petroleum Geologist

Many years ago anyone who looked for minerals or mineral fuels was called a *prospector*, thought of as a grizzled old man with a burro and a pan, way back in the hills looking for gold or silver. Today's prospectors are much different but still have basically the same objective, to find mineral and mineral fuel deposits in quantities large enough to be commercially valuable.

The petroleum geologist is an example of the modern-day prospector whose major responsibility is to determine where to drill oil and gas wells. This decision can only be made by a person who is familiar with the kind of geology in areas where oil and gas have been found before.

When a drilling operation starts the petroleum geologist must constantly check the core samples that are brought up and very often must check on several operations at the same time. Much of the petroleum geologists time is spent out-of-doors.

All petroleum geologists are graduates of a four-year college program. There are also technical occupations in the field of petroleum geology that require a two-year degree.

Mine Conservation Technician

All mining operations today are affected by federal and state conservations laws. The mine conservation technician usually works for the mine operator and makes sure that all regulations are followed. Mine conservation technicians working for open pit mine operations must see that the land is returned to a condition similar to what it was before mining started. Soil must be put back, grading must be done, and trees must be planted. The mine conservation technician must be able to understand government regulations and supervise the people who operate the grading equipment and plant the new trees.

Mine conservation technicians also work in the "deep" mines underground to discover and stop dangerous environmental conditions caused by poor mining practices. They check the land, water, and air around the mine site to see if the mine is causing pollution. Stopping mine fires is also an area where the mine conservation technician plays a part.

Most of the occupations in mine conservation technology require a high school degree plus two years of technical training.

PEOPLE WHO WORK WITH LAND SPACE

Land Planner

Man is a social animal, which means that most human beings like to live near others. They don't, as a rule, want to spread out. When many many people live on a small portion of the land, a land planner can help to make the best use of land space.

The land planner tries to fit the needs of people into the land space that they occupy and must know the natural resource capability of the land being used, such as something about geology to determine whether or not the ground will support buildings, and something about water and sewage to make sure that people have enough water to drink and that the soil will take care of sewage. The recreation needs of people must be known so that decisions can be made about where to put parks and playgrounds.

A four-year college degree in land planning or landscape architecture is required for most land planning positions. There are many technical positions in assisting land planners that require two years of college training.

PEOPLE WHO WORK WITH AIR

Air Quality Tester

The increasing industrial productivity and transportation needs of the country have caused an ever increasing air pollution problem. The air quality tester collects air samples where pollution is suspected and tests them to determine the amount of pollution present.

The air quality tester must, therefore know how to use the rather sophisticated testing equipment available today and how to determine when and where the samples should be taken. He needs to know the difference between clean and polluted air, and how much pollution can be tolerated before there is danger to people.

Air quality testers are usually graduates of 2-year technical programs in air pollution technology.

PEOPLE WHO WORK IN RECREATION

Interpretive Naturalist

The interpretive naturalist provides information about t
natural world to people who visit national, state, and local par
and museums. Naturalists must be teachers, communicators, a
researchers.

The naturalist uses the out-of-doors as a classroom includi
biology, zoology, botany, geology, and the natural and ear
sciences. The naturalist usually has a college degree in one of t
above and a great deal of knowledge about the rest. Most of
time is spent out-of-doors, but the naturalist must also be able
give effective indoor presentations using audio-visual equipme

EVALUATION:

Given the opportunity to identify and describe occupations
the natural resources, children will give answers that indica
that they understand that people must take care of natu
resources.

Section C - Soil

Topic I

WHAT IS SOIL?

GOALS: After this lesson children should:

Know that soil is made up of air, water, broken down rocks, organic matter, and living organisms.

Understand the interaction of the various soil components.

TEACHER'S NOTE: All activities suggested here will be based on the assumption that there is a place on the school grounds, or nearby, where children may learn about soil. These experiences will involve digging and sometimes removing a small amount of soil for further study in the classroom.

In some situations, the above assumption is not appropriate.

If this is true, teachers must find some soil to bring into the classroom.

ACTIVITY 1: Becoming Acquainted with Soil

A. Temperature and Water

Have the children take a sample of the school ground soil or other appropriate places and explore it with as many senses as they can. The the following questions may help:

What can we learn about the soil by feeling it?

Is it cool or warm? Is it moist or dry?

If you squeeze a little bit of it in your hand, does it stick together? What makes it stick together?

Does soil have water in it?

B. Rocks and Organic Matter

Have each child collect or give them a small sample of soil (about 2 cubic inches) and put the sample in the middle of a piece of 8-1/2" x 11" paper.

Providing the children with a hand lens, magnifying glass, or low power microscope, will make this experience much more fun and meaningful.

Direct the children to separate the soil sample into things that look different and things that look alike. Remind them that they are still trying to discover what makes up a soil. The following questions may help:

Is there anything that looks like wood?

Is there anything that looks like it used to be a part of a tree or plant? (Roots, leaf particles, stems, old leaves.)

Does anything look like small rocks or sand?

Are there any worms or insects in your soil?

TEACHER'S NOTE: In an ideal soil one might find all of the above. This will not generally be the case, however. The very least a teacher should expect from the above activity is to have the children discover that two more components of soil are *rock particles* and *plant parts* (organic matter).

C. Air

One way to demonstrate "soil air" to the children is to place a sample of soil (preferably one that is moist and fresh) in a jar and slowly pour water down the side of the jar until the water covers the soil by 3 to 4 inches.

Air will escape from the soil and can be observed rising to the top of the water.

Should the soil be disturbed when the water is poured into the jar, simply allow it to settle before observing it.

D. A Living Organism

The following demonstration will help teachers and children to discover the reality of living organisms in a soil.

Materials needed:

Two sections of soil that are approximately the size of any pan that one would use to bake a small meat loaf or bread (approximately 8" x 4" x 4"). These sections should come from any place where weeds might be or are growing or from the floor of a woodlot or flower bed.

Two containers of equal size, one of which can be put into an oven. Aluminum pie pans will do.

Procedure:

a. Mix the soil samples together in a box.

b. Put 1/2 of the mixture into one container and 1/2 into the other.

c. Put one container in an oven for about 45 minutes at approximately 300° (this will sterilize the sample). (The soil should be sprinkled with water and covered tightly with a sheet of aluminum foil to hold in the steam before being placed in the oven.)

d. Remove the sample from the oven and place it next to the other one on a window sill and water each one equally daily as required.

e. Observe the results over a 2 to 3 week period of time.

TEACHER'S NOTE: The living organisms in a soil are different from the organic matter discussed earlier. Organic matter indicates something that was once alive but is now dead. Organisms include bacteria, insects, plants, seeds, worms, and many other living things that live in and interact with the soil.

This demonstration will simply allow the children to see that there are living things in the soil. Let them follow you through the demonstration, including the baking of one sample.

EVALUATION:

Given the opportunity to answer the question: if you were to make some soil, what kinds of things would you need? Children will demonstrate their knowledge of soil components by having the following in their answer: air, water, rocks, organic matter, and living organisms.

SOIL FORMATION

GOALS: After this lesson children should:

Understand the concept that soil is a renewable natural resource, and that its renewal takes tremendous time.

Understand these terms: weathering, soil parent material, soil profile, and horizon.

Understand basic concepts of soil formation.

Begin to understand the relationship of one area (horizon) of a soil profile to another.

Have the basis for a better understanding of the soil topics that follow.

TEACHER'S NOTE: The introduction of the "soil profile" is done here because it will give the children the total picture of "a soil" from bedrock to surface. Knowing what a profile is will help the children to understand better the topics that follow.

ACTIVITY 1: Discussing Soil Profiles

Ask the children to define the word *profile*. When they have arrived at the conclusion that a profile is really a "side view" then ask them to use their imagination and do the following:

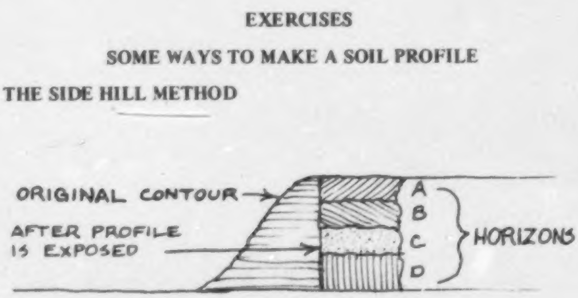
> Start at the top of a regular piece of notebook paper and draw what you think a soil profile might look like. You may use words at the side of your drawing to describe what you might find as you go deeper into the soil. Make sure that your picture shows where you think soil begins and ends. (Collect the drawings when the children are finished.)

TEACHER'S NOTE: The purpose of this little exercise is to help teachers to find out what children think they will find in a soil profile, and to make comparisons between what they will find and eventual discoveries.

EXERCISES

SOME WAYS TO MAKE A SOIL PROFILE

THE SIDE HILL METHOD



Find a side hill and dig straight down until profile is exposed.

Using Master C-1, have students identify the soil horizons. Using the posterboard and glue method described under the Auger Method, have the children take samples and prepare a model of the soil profile.

THE AUGER METHOD

If you have a soil auger available the following method may be used to make a profile.

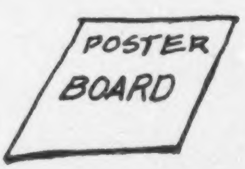
You will need:

Poster board, 9" x 22"
White glue
Soil auger

Procedure:

a. Fold poster board along the long axis.
b. Cover middle fold with glue.
c. Take a sample of soil from every 2 inches that the auger goes down into the ground.
d. Put soil samples on board as they are taken out of ground.
e. Press soil gently into glue and allow to dry, for an hour or so.

①



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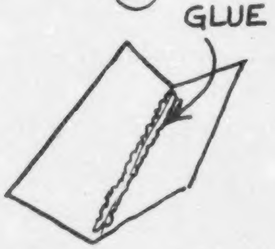

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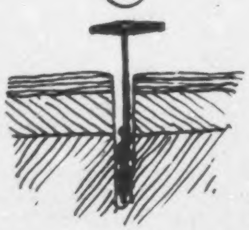

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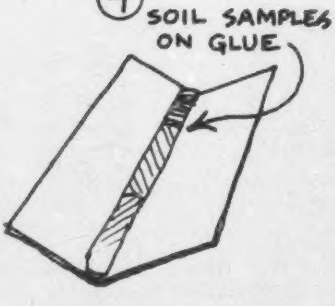
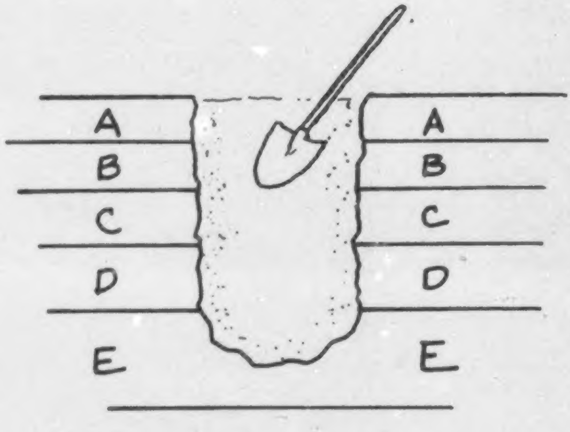


THE POST HOLE METHOD

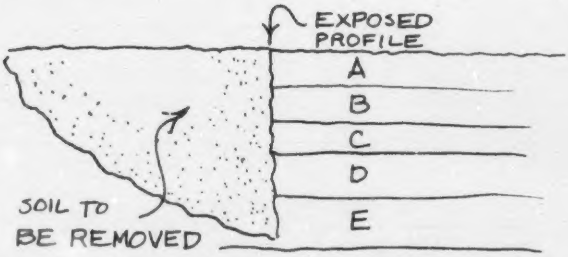
Procedure:

a. Dig a hole straight down into the earth. Take a sample from each level that you dig out and place it on the poster board in the same manner as in the auger method. Then fill up the hole. This method will work but is not as easy as any of the other methods.

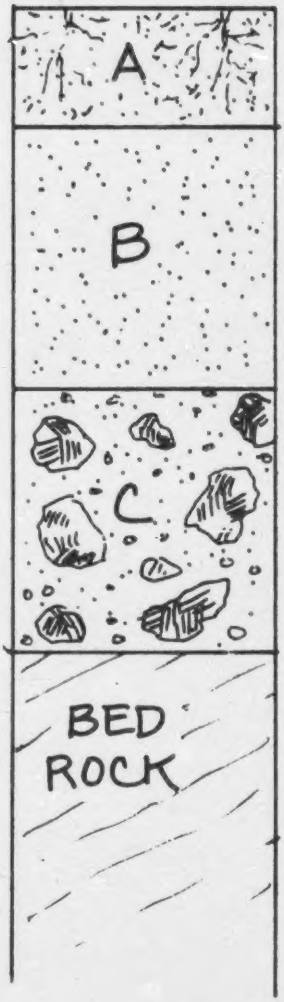


THE ANGLE-IN SLOPE

If a hill is not available for exposure of the soil profile, but only flat land exists in the study area, the soil may be removed at an angle into the ground, exposing the soil profile in a vertical wall as shown in the figure. Samples may be taken, and a model of the soil profile prepared as previously described. Fill the hole when the study has been concluded.



MASTER C-1



WHAT MIGHT BE FOUND	COLOR
PLANT AND ANIMAL DEBRIS AND NEW SOIL, ROOTS, INSECTS.	VERY DARK BROWN OR RED
RATHER CONSTANT PARTICLES OF THE SAME SIZE AND COLOR.	LIGHTER THAN A HORIZON, MAY CHANGE AS YOU GO THROUGH IT.
LARGE ROCK PARTICLES CALLED SOIL PARENT MATERIAL.	WILL BE LIGHTER THAN A AND B, AND ABOUT THE COLOR OF THE ROCK UNDERNEATH IT.

TEACHER'S NOTE: This publication is for nationwide use. It is therefore impossible to show you exactly what a soil profile from your area will look like. The profile chart shown above is typical of a soil suitable for growing crops. There are three areas (A, B, C) called horizons, and each horizon plays a particular part in the formation and functioning of soil. The depth of these horizons varies considerably. In some very shallow soils, B and C horizons may be lacking altogether.

ACTIVITY 2: Making a Soil Profile

There are several ways to make soil profiles, most of which can be found on Worksheet C-1.

Tools needed for this activity will be one or more of the following: a shovel, a post hole digger, a soil auger. A soil auger may be borrowed from a soil conservation service representative if one is not one available in the school. High schools with vocational agriculture programs would be another source of equipment. The auger method of making a soil profile is the best because it requires less work, less space, and disturbs hardly any land. Make sure the children get a good indication of the changes on their poster board.

After the profile has been exposed and a sample of it has been made, ask the children the following questions:

What changes did you notice as the soil profile got deeper?

We noticed in the A horizon the breakdown of organic matter. Is this how a soil gets its organic material, and if so, how does the organic matter get down into the soil?

The middle horizon B may be looked at as the mixing bowl. Organic matter from the top and soil parent material from the bottom meet and mix to form the B horizon. Why is this important to plants?

The C horizon of a soil is called the *soil parent material*. Soil parent material is made up of broken down rock. The rock is broken down by a process called *weathering*. Gradually the particles get smaller and smaller. Why is this important to soil formation?

EVALUATION:

Given the opportunity to explain soil formation, a child will demonstrate an awareness of the following concepts:

The relationship of soil parent material and weathering.

The relationship between the formation of soil parent material and the addition of organic matter.

The relationship of one area of soil profile to another.

Given the opportunity to define the following terms children will give a definition that indicates an understanding of the terms:

Soil profile
Soil horizon
Weathering
Soil parent material
Soil formation

Section C - Soil

Topic III

SOIL AND WATER

GOALS: After this lesson children should:

Understand the relationship of water to soil formation.

Be aware of the effect of man on soil.

Understand the terms drainage and percolation.

ACTIVITY 1: Experimenting With Percolation and Drainage in the Classroom

Water falls to the earth as rain and then does one of two things: goes down into the soil or runs off on top of the soil.

Percolation and *drainage* are the terms applied to the movement of water down through a soil or the way water runs off of or through a soil.

Demonstration in the Classroom

Materials needed:

The inside parts of a coffee percolator.

Place about 3/4 inch of coffee in the top.

Place the coffee holder in a bowl to catch the results of the experiment.

Pour enough hot water into the top to cover the coffee and observe the results.

Ask the children the following questions:

Why is the water in the pan or bowl now the color of coffee?

Where did the color come from?

Could we say from our observation of this experiment that when water moves down through coffee it takes some of the coffee with it?

What would happen if we replaced the coffee with soil?

ACTIVITY 2: Experimenting with Soil Percolation and Drainage Outside the Classroom

In the following exercise, have students perform a percolation test.

EXERCISE

MAKING A PERCOLATION TEST

Materials needed:

1 watch (either a stop watch or a watch with a second hand).

1 one-lb coffee can with both ends cut out of it.

1 one-pint jar or cup (so long as this container is the same size for everyone it can hold any amount of water that is less than the coffee can would hold).

1 plastic jug for carrying extra water.

Procedure:

a. Select four spots on the school grounds or nearby. Two of these spots should be places where people seldom or never walk.

Examples:

The middle of a yard that doesn't get much traffic

A flower bed

Under shrubs and bushes

b. The other two spots should be places where people have obviously affected the soil by walking on it or standing on it.

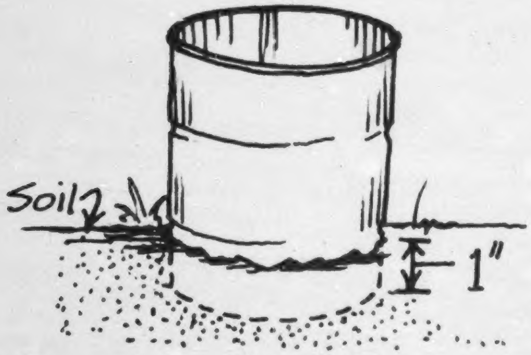
Examples:

The area around home plate

The area under swings or see-saws

The corners of buildings where pathways usually are found

Any other place where the soil is stepped on by people



c. Have the children work in teams of three with each child doing one of the following tasks:

1. Set can in place and pour water
2. Timing
3. Recording
4. One child should also describe the test site

The following chart may help in recording the results:

Site	Amount	Time	Rate	GPM
1	1 qt	90 sec	1 qt/90 sec	1/12 gal/min
2				
3				
4				

Rate of percolation should be figured as amount of water/time (see example below) and converted to gallons/hour.

1 qt/90 sec = 1 gal/520 sec = 1 gal/12 min
or 1/2 gal/min

d. Push the coffee can into the ground at the selected site so that water poured into it will not seep out from under the edge. (See Figure C-1 below.) All the can does is act as a sleeve. The lower edge should be pushed into the soil about 1 inch.

e. Measure 1 pint of water and pour it directly into the top of the coffee can.

f. Note and write down the time as soon as the water is poured in.

g. Note and write down the time it takes for the water to disappear. The difference in time is the *percolation rate*. (This may be very rapid or very slow depending on the soil type and condition.) You may want to see how long it takes for the water to drop 1 inch or 2 inches. As long as everyone does the same thing, it does not matter. You are finding the rate of percolation.

After the tests have been made, have the teams draw conclusions based on the following questions:

What kind of results did you expect when you started this experiment?

What general things could we say about each of the two kinds of areas we observed?

What was the percolation rate at each of the sites?

How and why were they different?

When the children have discovered that soil where people walk will not percolate as rapidly as soil that is not walked on, ask the following questions:

Why does standing on the soil cause water not to drain through it?

What words could we use to describe what might happen to a soil that was continually stepped on?

TEACHER'S NOTE: The technical terms for soil that is treated in the above manner are *impaction* or *compaction*. Activity 3 may help you and your children to understand this concept better.

ACTIVITY 3: Studying the Effect of Soil Impaction and Drainage

Figure C-1 shows a microscopic view of soil particles in a non-compacted situation. The spaces between the soil particles are called *pore space*. As soil becomes compacted, the soil particles are so close together that water will not flow down through the soil.

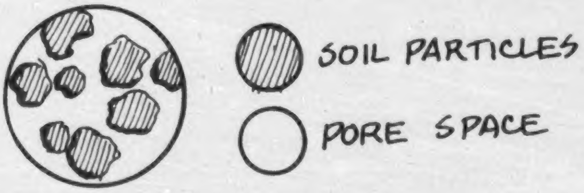


Figure C-1

TEACHER'S NOTE: The ability of a soil to hold water is related to the amount of surface area present in the form of soil particles. The water attaches itself to the surface of the soil particles and is held there. Pore space simply allows water to contact the individual soil particles.

Ask the children the following questions:

What happens to soil particles when a soil is compacted?

What relationship does soil compaction have to soil drainage?

If the soil on your school grounds is holding all the water it can and it starts to rain, what will happen to the water?

Will the water run off at the same rate from all parts of the school ground?

What determines the rate of water runoff other than the percolation rate?

TEACHER'S NOTE: The *degree of slope* on a soil will affect the rate of run off and the rate of percolation.

What would happen to water that falls on perfectly level land that will not absorb any more water?

TEACHER'S NOTE: Soil that will not absorb any more water or is "filled up" has reached what is called *field capacity*. If the percolation rate of a lawn is 1 inch per hour and a downpour causes 2 inches of rain to fall in one hour, 1 inch will be absorbed and 1 inch will either run off or if the lawn is perfectly level, will lie there and evaporate. This can be observed very nicely if there is a ball field or playground on the school grounds. After a rain, water puddles will usually form in the area around home plate or under see-saws or swings.

ACTIVITY 4: Determining the Effect of Percolation on Soil

Two major areas of a soil profile are affected by water percolation. They are: (1) the movement of organic matter and nutrients from the top layer of soil down to where root systems are; (2) weathering of rocks that forms soil parent material.

Prepare an overhead transparency from Master C-1 to explain this concept.

Point out:

Rain falls on soil and because of gravity starts to move down.

As water moves through the surface soil, it picks up nutrients from the organic matter and carries them through the A horizon and into the B horizon.

Material from the surface is deposited in the B horizon called the "zone of accumulation."

Water that is not used by plants or other living organisms in the soil finally reaches the soil parent material where it usually drains away.

Water that reaches bedrock runs along the plane of the rock and enters the water cycle at a spring, stream, river, or well.

Horizon A is often called the "zone of leaching." Leaching is the term used to describe the removal of a material by water. (Coffee grounds have been leached of their soluble material.)

EVALUATION:

Given the opportunity to define the following terms, the children will demonstrate an understanding of the meaning of the terms:

percolation, runoff, field capacity, percolation rate, pore space, impaction, degree of slope.

Given the opportunity to trace a drop of water from the surface to the bedrock of a soil profile, children will indicate an understanding of the relationship of water to the development of soil.

Given the opportunity to answer the question "Can you tell one way that man has a negative effect on soil?" children will give an answer that indicates that the child understands the relationship of walking on soil to pore space and the relationship of pore space to water-holding capacity.

Section C - Soil

Topic IV

SOIL AND PLANTS

GOALS: After this lesson children should:

Know that plants are very important to soil because they help to prevent soil erosion and also provide organic matter to the soil.

ACTIVITY 1: Discussing Decomposition and Organic Matter

Children should understand that the term "organic" indicates something that was once living but has since died and is in the process of decomposing. Activity 1 from Topic VI, Section B, will serve as a good review and discussion guide of the relationship between soil renewal, organic matter, and decomposition.

ACTIVITY 2: Discovering Examples of Organic Matter

Have the children go outside the school building and explore flowerbeds and areas under trees and shrubs. Ask them to find things that were once alive but are now nonliving and are undergoing decomposition. The following questions may help:

What are some of the things we notice about things that are decomposing?

Do they change color and texture?

How do they smell?

How long do you think it will take for the leaves that have fallen this year to turn into part of the soil?

What other evidence of living things can you find?

ACTIVITY 3: Testing for Organic Matter in the Soil

TEACHER'S NOTE: The following activity will depend on the availability of soil testing facilities. Contact the state university or district office of the Soil Conservation Service and obtain information on the procedure for getting soil samples tested.

This activity is a very good way to show children the effect of plants on the organic content of the soil and to provide an interesting math problem.

a. Contact the district office of the Soil Conservation Service or state university and have them send information on how a soil sample can be tested for organic matter content.

b. Have the children go out on the school grounds and collect samples of soil from the following kinds of areas:

An area where there are no plants growing at all (ball field base paths, home plate, etc.).

An area where grass is growing.

An area where trees and shrubs are growing and dead plant material is evident on the surface of the ground.

c. Send samples to the address obtained in Step A. (Usually soil testing laboratories will send small packets to put the soil in.)

d. When results return, make a graph similar to the one in Figure C-2 below.

e. Did the sample with lots of plant cover also contain a large amount of organic material?

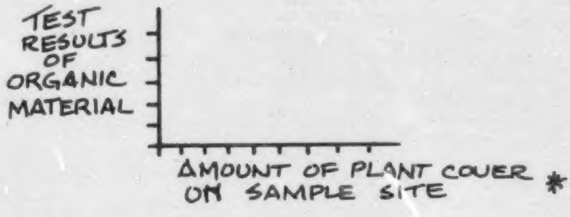


Figure C-2

ACTIVITY 4: Discovering How Plants Help to Hold Soil in Place

Using the following exercise, have the children make a soil runoff demonstration table and do the experiment.

After the experiment, discuss the following:

Why did we find more soil runoff from the uncovered sample?

How do plant roots help to hold soil in place?

Do plants have any other effect on soil protection?

Have the children dig up a small amount of grass (a teaspoonful is a small amount) and look at it under a microscope. Ask them to try to discover just how plant roots are attached to soil.

EVALUATION:

Given the opportunity to answer the question "What do plants do for soil? children will indicate by their answers that they know that plants supply soil with organic matter and help to stabilize the soil.

EXERCISE

HOW TO MAKE A SOIL RUNOFF BOARD

You will need:

2 plastic milk bottles (the more nearly square the better)

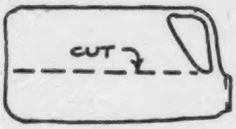
2 tin cans

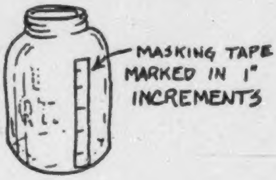
2 quart jars

Procedure:

a. Cut the milk bottles in the manner shown below to make trays.

b. Mark the quart jars with masking tape in the manner shown below.





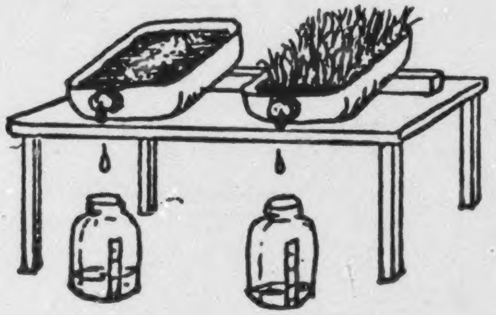
c. Punch holes in the bottom of the cans to make sprinkling cans.

d. Obtain one piece of sod that will fit exactly into one of the milk bottle trays; or fill both milk bottle trays with soil and plant rye grass in one of them.

e. As soon as the sod has had a day or two to settle or the grass has grown to about 5-6" (about 2 months), set the two trays side by side as shown below.

Block up the trays so that they slope about 1 inch from the back to pour out spout.

Place the marked jars so that water from the trays will collect in them.



f. Slowly pour 1 quart of water through the cans so that it falls onto the middle of each of the samples.

g. Record and observe the amounts of water and soil collected in jars.

Questions:

1. Which jar has the most water?
2. Does grass help hold water?
3. Which jar had muddy water?

Section C - Soil

Topic V

SOIL PARTICLES

GOALS: After this lesson children should:

Understand that soil is classified by particle size.

Understand the relative size of sand, silt, and clay particles.

ACTIVITY 1: Making a Mechanical Analysis of Soil

Have the children collect from the school grounds or bring from home various samples of soil that they have been able to identify as having a particular color or characteristic that they can identify usually by feel.

In this method simple sedimentation is employed with a minimum of laboratory equipment.

Materials needed:

Various soil samples, 1/2 cup of each

1 fruit jar and lid for each sample

8 percent Calgon solution – Mix 6 tablespoons of Calgon per qt of water

Ruler – graduated in the metric system

Measuring cup

Tablespoon

Procedure:

a. Place approximately 1/2 cup of soil in a quart jar. Add 5 tablespoons of the 8 percent Calgon and 3 1/2 cups of water. Cap and shake for 5 minutes. Place the jar on the table and let stand for 24 hours.

b. At the end of 24 hours, measure the depth of settled soil. This represents the total depth of soil. Shake thoroughly for 5 minutes. Place the jar on the desk and let stand for 40 seconds. Now measure the depth of settled soil with a ruler. This is the sand layer.

c. At the end of 30 minutes, measure the depth of settled soil and subtract the depth of sand from this depth to get the depth of the silt layer.

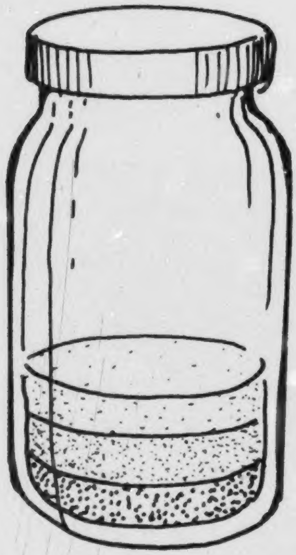


Figure C-3

d. The remaining unsettled part represents the clay fraction.

e. Record your results for each of the soil samples.

The measurements may be converted into percentage figur according to the following examples:

	A	B
a. Total depth of soil	23 mm	35 mm
b. Depth of sand layer	9 mm	13 mm
c. Depth of silt layer	10 mm	10 mm

% Sand equals $\frac{9\text{ mm}}{23\text{ mm}}$ x 100 % = 39% $\frac{12\text{ mm}}{35\text{ mm}}$ x 100% = 34.3

% Silt equals $\frac{10\text{ mm}}{23\text{ mm}}$ x 100% = 43.5% $\frac{10\text{ mm}}{35\text{ mm}}$ x 100% = 28.6

% Clay equals 100% – (39% plus 43.5%) = 17.5%
100% = (34.3% plus 28.6%)
= 37.1%

EVALUATION:

When asked to name the three general soil particle si classification, children will say clay, silt, and sand. When ask to put the three particle size classifications in order, ranki from larger to smaller, they will say sand, silt, and clay.

When answering the following questions, children will gi answers that in the opinion of their teacher are satisfactory.

Which of the soils tested in Activity 1 would hold the mo air?

Which of the soils tested in Activity 1 would allow water percolate faster?

Which of the soils tested in Activity 1 would have the mo pore space?

Section C - Soil Topic V

SOIL AND AIR

GOALS: After this lesson children should:

Know that soil has an atmosphere of its own and that the air capacity of a soil is directly related to its structure and condition.

Have developed an awareness through classroom discussion of the relationship of a soil's living organisms to the soil air.

ACTIVITY 1: Discussing Soil Particles and Air

Review Topic I, Activity 1:

We have seen that there is air in soil. Where do you think this air is located?

What did we mention when we discussed water that might give us a clue to where air might be located in the soil?

TEACHER'S NOTE: Soil scientists classify soil particles by size. Sand ranges from 0.5 to 2.0 millimeters, silt from .002 to 0.5 millimeters, and clay those smaller than 0.002 millimeters. Most soils are made up of particles that are combinations of the above. It is important to understand this concept, because particle size is important to the airholding capacity of a soil, as well as the amount of pore space in a soil.

The capacity of a soil to hold air is dependent upon soil particle size because soil particle size determines the amount of cavity or pore space that will exist between particles. The diagram in Figure C-4 below will help to illustrate this point.

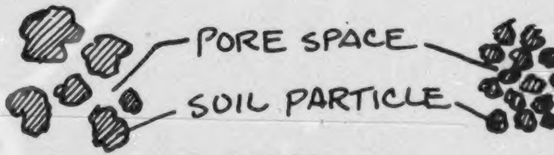


Figure C-4

Ask the children this question:

Will a soil with large particles hold more air than a soil with sm particles?

ACTIVITY 2: Demonstrating the Effect of Particle Size on Po Space

Using two water glasses of equal size, fill one with marbles a one with BBs. Have the children pour measured amounts water into each glass until it is full and then ask the followi questions:

Which of the glasses took the most water?

Which of the glasses has more space between particles?

Which class of soil has the most air space?

TEACHER'S NOTE: The material above should be related to effect of pore space on drainage. Soil with larger particles usually drain more rapidly and therefore leave more space for air a soil is poorly drained and water remains in the pore spaces capacity will be less.

ACTIVITY 3: Studying the Relationships of Living Organisms and Soil Air

Plant root tissues and very small soil organisms (everything from earthworms to bacteria) constantly use oxygen and give off carbon dioxide. Both of these gases have a characteristic that is very important to the needs of soil organisms. This is called *diffusion*, which means that a gas (CO_C or O_2) will move toward and occupy an area of lesser concentration. The following diagram may be helpful in understanding this concept.

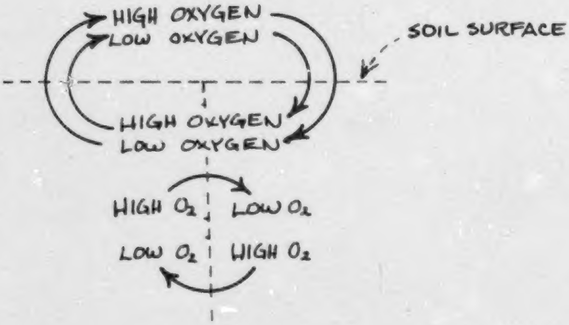


Figure C-5

Point out to the children that the movement of gases is very important in maintaining the balance of the soil atmosphere. After an explanation of this concept, ask the children to solve the following problem.

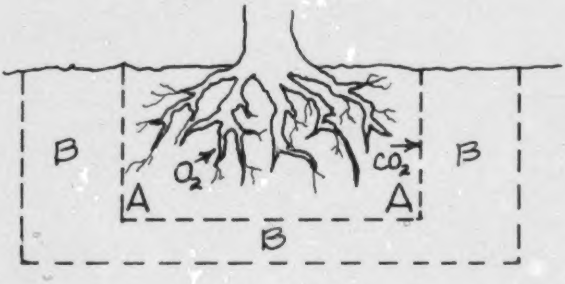


Figure C-6

If in the above diagram the tree roots are within line A, which way will soil oxygen move, from area A to area B, or from area B to area A? Answer the same question about carbon dioxide.

TEACHER'S NOTE: Figure C-6 is very arbitrary and meant for illustration only. In actual fact the areas of gaseous concentration are much more subtle and seldom could they be defined as a straight line or area A or B.

EVALUATION:

Given the opportunity to define the following terms – *pore space, soil, air,* and *diffusion* – children will give a definition that demonstrates a basic understanding of the terms.

Given the opportunity to answer the question: Will a soil with large particles hold more air than a soil with small particles? The children will answer that the soil with larger particles will hold more air. When asked why this is true, they will respond in a way that will indicate their knowledge of the proper relationship of pore space to air-holding capacity and pore space to soil particle size.

When asked to discuss the relationship of living things to soil air, children will demonstrate by their comments that they have an understanding of the fact that plant tissues and other soil organisms use oxygen and give off carbon dioxide and that these gases move from areas of high concentration to areas of low concentration.

Section C - Soil

Topic VII

HOW SOIL IS MOVED

GOALS: After this lesson children should:

Understand that soil and soil parent material are moved by wind, water, and gravity.

Understand that the movement of soil parent material is an important factor in the formation of different kinds of soil in different parts of the world.

Understand that soil that is not stabilized by plants will be moved by wind, water, and gravity.

ACTIVITY 1: Observing Evidence of Soil Movement

Soil movement by water can be observed on any hillside that is not covered with plants of some sort. This is one of the most common forms of *erosion*.

Bank erosion can also be observed on any stream that curves in and out.

Stream bank erosion can best be observed on the side of the stream where the water curves into the bank.

If you have school grounds where you can find some bare ground and some ground covered with grass or other plants (such as a ballfield), the experiment on Worksheet C-3 will be very helpful in showing children that water does move soil and that plants stabilize soil (see Topic IV, Soil and Plants).

Followup suggestions for this activity include:

Why are swales planted with grass that is never disturbed?

What is the purpose of a diversion terrace? Why is it grassy?

By means of a field trip or slides, show the children contour planting of field crops. Why is the field plowed across the slope and not down it?

What is the purpose of grass strips across the slope?

Evidence of soil movement by air can be observed by blowing on any dusty shelf or by observing the wind blowing dust around.

Soil movement by gravity is difficult to observe unless you have some very steep slopes that are covered with shallow soil and very little or no ground cover.

ACTIVITY 2: Discussing the Movement of Soil Parent Material

Make an overhead transparency from Master C-2, and explain the movement of soil parent material.

TEACHER'S NOTE: The movement of soil parent material by natural forces is one reason for the many and varied soil classifications that we have in this country. For further information on soil classification and the origin of soil parent material in your area, consult the district office of the Soil Conservation Service.

EVALUATION:

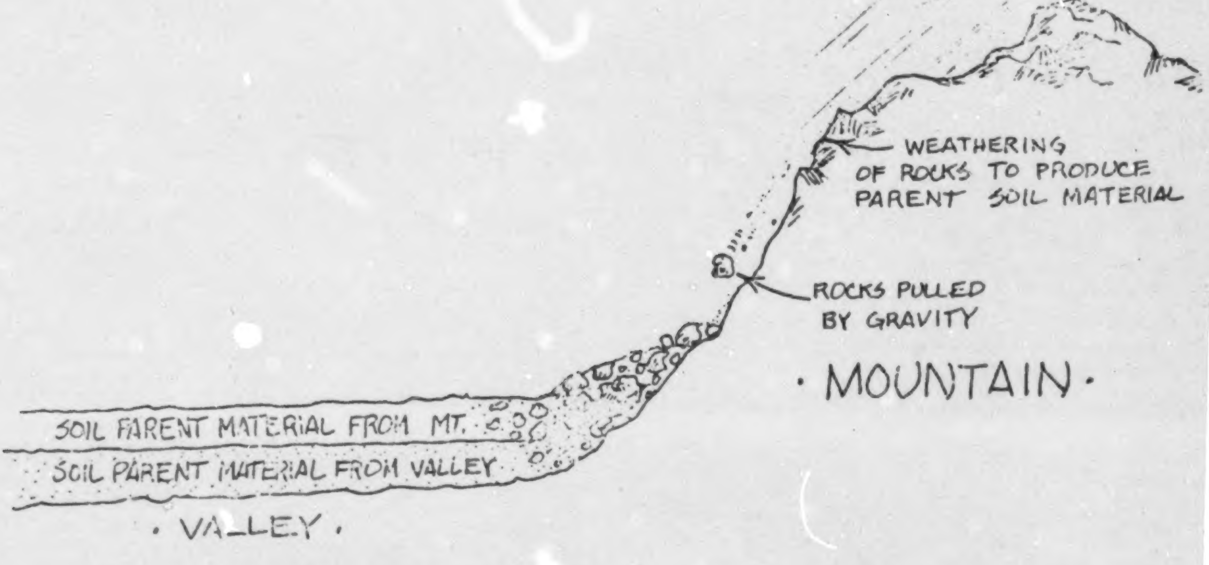
Given the opportunity to tell how soil is moved by natural forces, children will demonstrate their knowledge that it is moved by gravity, wind, and water.

Given the opportunity to discuss the importance of ground cover for soil stabilization, the children will demonstrate by their comments that they appreciate the value of plants in soil stabilization.

If asked the question: why are there different kinds of soil in different parts of the country? Children will answer the question in a way that will demonstrate that they know the movement of soil parent material by wind, water, and gravity, and appreciate the relationship of the concept to the formation of different kinds of soils.

MASTER C-2

1. Rocks in valleys and on mountains are weathered and turn to soil parent material.
2. Rocks from mountains are washed, blown, or rolled down to valley.
3. Soil parent material from the mountain mixes with soil parent material and organic matter from the valley and makes a soil different from either of the two areas.
4. Soil at the base of the mountain will be different from the soil farther out in the valley.
5. These processes are going on all of the time.


WIND & RAIN
WEATHERING OF ROCKS TO PRODUCE PARENT SOIL MATERIAL
ROCKS PULLED BY GRAVITY
· MOUNTAIN ·
SOIL PARENT MATERIAL FROM MT.
SOIL PARENT MATERIAL FROM VALLEY
· VALLEY ·

Section C - Soil

Topic VIII

MAN'S EFFECT ON SOIL

GOALS: After this lesson children should:

Understand one of the ways that people affect soil.

TEACHER'S NOTE: This topic is similar to Topic VI, Grades 3-4, but the activities are more appropriate for Grades 5-6.

ACTIVITY 1: Identifying the Problem

The school ground in most suburban areas is covered with soil. Children play on the school ground. It should therefore be obvious that they have some effect on the soil.

Have the children go outside for a period of exploration. They will be looking for particular places where they have caused a surface change in the appearance of the ground.

What is soil? Have the children take some soil from different areas (where they constantly walk, and where they don't) and bring it into the classroom on a plain sheet of paper, and try to separate the different things they find and note differences. This can be done in teams.

Answer the question, what is soil made of? Using a hand lens or microscope, see if the children can discover what kinds of things make up the different kinds of soils. Rocks, root stems, plant parts, worms, water, air, just what is there?

From the observations made during the trip questions should evolve, such questions as: what happens when we constantly walk over the same place? Does it change the soil to step on it constantly? Will plants grow in these areas? Why does water always stay in these areas longer than other places?

ACTIVITY 2: Measuring Soil Compaction

How can we find out what happens when we step on soil? The best way to get this answer is by a comparative study. First ask the children what they think happens to the soil. Does it get hard and if so, does this affect its ability to hold water or grow plants?

One way we can answer the hardness question is by running a simple penetration experiment:

a. Get one pound of 10 penny nails, and a 12-inch ruler.

b. Going back to the place where they made their original observation, have them try to push the nail into the soil with one finger, then two (thumb and forefinger grasp). Caution the children not to press with the palm of their hand.

c. Measure how much of the nail stuck out of the soil after pushing with one finger.

d. Make a note of the distance above ground.

e. Repeat the same procedure using the same steps, only change the area to any place where there is no visible evidence that man has affected the soil.

f. Have the children write down the number of inches of nail visible after they performed the experiment.

g. Back in the classroom have the children average the distance in man-affected soil and in non-affected soil.

Now we know the soil is harder where man has stepped on it but does this make any difference?

Our observations tell us that there were no plants growing on the soil where we walked. Was this because we killed the plants that grew there before they had a chance to grow, or because soil that is hard or *compacted* does not grow plants as well as the softer soils? How can we find out?

a. Get some flower pots and a packet of bean seeds.

b. Simply collect soil from the same two areas as above and plant the seeds in them.

c. Try to collect some samples of the impacted soil without breaking it up too much.

d. Place the samples in a place where they will receive the same amount of sunlight and water.

e. Water them well whenever the surface is dry. Keep records of how much water was used.

f. Observe the growth of the bean plants and note differences.

This experiment will yield further evidence regarding man's effect on the soil.

Does stepping on the soil cause water to not go down into the soil where it can cleanse itself and be used by plants? How can we find out? What did our observations tell us? Discuss with the children what happens to water as it hits the soil? What would happen if it all stayed on top? Will stepping on the soil in the same place all the time cause this to happen?

a. Get enough number 10 cans or any large tin cans for every child in the class to have one.

b. Cut both ends out of half of all the cans.

c. Fill the other cans 1/2 full of water.

d. Return to the spots where man has affected the soil.

e. The children should be working in teams of two, one with a can with water and one with a cylinder.

f. Place the can with both ends cut out down into the soil about 1 inch.

g. Pour the water from the other can into this.

h. Note the time it takes for the water to drain or percolate down into the soil.

i. Repeat the above process in an area not affected by people.

j. Back in the classroom discuss the differences that the children found. What does this mean to plants, animals, the water itself?

EVALUATION:

Given the opportunity to discuss the effect of people on the school ground soil, children will demonstrate that they are aware of things such as compaction and the relationship of a compacted soil to plant growth and percolation.

SOIL CONSERVATION OCCUPATIONS

GOALS: After this lesson children should:

Be aware of the occupations that exist in the area of soil conservation and management.

Understand the nature of the work performed by soils workers.

ACTIVITY 1: Discussing Occupations in Soils

TEACHER'S NOTE: We use the *On-Site-Soil Scientist* to denote the soil scientist who actually does on-site work with soil as compared to the soil scientist who spends time in a laboratory doing basic physical and chemical tests on soil.

The basic job description of the *On-site Soil Scientist* would be that of an information obtainer and problem solver. Suppose, for example, a building developer wants to use a particular portion of land for building houses. His first problem is to determine whether or not the soil in the area is suitable for this kind of use. The on-site soil scientist would be called and would probably do these things:

a. Gather all available information about the kinds of houses that are being planned.

b. Gather all available information about the soil.

c. Identify information that is necessary but not available.

d. Work with soil technicians to gather any additional information necessary.

e. Relate all available information about the soil to the needs of the housing development and to the rest of the community.

f. Make recommendations to the housing developer that will enable him to use his land properly.

The on-site soil scientist must have many different kinds of knowledge. He must know the general characteristics of all soils and the particular characteristics of the soils in the area where he works. He must be familiar with all methods of obtaining information about soils, including not only field sampling techniques but also library and computer resource materials. He must know or be able to determine what effect a particular kind of activity might have on a soil, and last but not least, he must know how to work with people.

Particular kinds of knowledge that the on-site soil scientist would need to have would include soil science, chemistry, geography, mathematics, mapping, surveying, and public relations.

Most soil scientists are graduates of at least a four-year college program in soil science, and very often have an area of specialization such as forest soils agronomy.

Any analysis of soil depends to a great extent on the information obtained from laboratory testing of soil samples gathered from particular areas. It is the job of the *laboratory soil scientist* to be able to answer particular questions about particular soils and get this information back to the people working on the site so that they can make proper recommendations. The laboratory soil scientist needs to be familiar with all available techniques for physically and chemically analyzing soil samples, and if given a particular use for a given soil, must know what soil changes to recommend based on his laboratory analysis.

The laboratory soil scientist is a graduate of at least a four-year college program and usually has a very strong background in the physical and chemical properties of soil, as well as the laboratory techniques necessary to determine these properties.

Soil technicians are important people in the area of soil conservation and work in both laboratory and on-site situations. In general, soil technicians are those who actually run the tests or collect the data needed by the soil scientists. The soil technician who works on the site, for example, would have to be very familiar with field sampling techniques to determine such things as percolation rate profile, soil chemistry, and degree of slope. The soil technician who works in the laboratory on the other hand, would be familiar with tests to determine such things as soil moisture, soil air, mineral content, and soil texture.

Soil technicians are high school graduates and very often have taken two-year programs after high school. In the future all soil technicians will probably need two-year post high school training in order to enter the field.

ACTIVITY 2: Interviewing Resource People

The most direct experience that children can have in learning about soil occupations is by meeting someone who actually is a "soil man." Contact your local, state or federal Soil Conservation Service and arrange for a visit of one of their people to your classroom. Local high schools with vocational agriculture programs may also be a good source of information and resource people in this area.

ACTIVITY 3: Preparing a Bulletin Board

Have the children develop a bulletin board of pictures of people working with soil. Group the pictures so as to illustrate clusters of similar careers. Have the students study and react to the display during a class discussion.

EVALUATION:

In an oral exercise, the student can identify at least three types of workers who help to manage and protect our soil.

The student can state how different soil workers contribute to his well-being and the welfare of the community.

Section C - Plants Topic I

PLANT COMMUNITIES

GOALS: After this lesson children should:

Understand that the environment is made up of physical and biotic factors that affect each other.

Understand the physical factors of the environment.

Understand that plant communities develop in areas where physical factors are suitable for them.

ACTIVITY 1: Identifying Biotic Factors

Ask the children to identify some of the living things that affect them, such as flies, rats, mice, cows, ants, birds, trees, flowers, shrubs, and mold.

Point out to them that all living things are *biotic factors* in our environment and that these biotic factors are affected by the *physical factors* that surround them.

ACTIVITY 2: Identifying Physical Factors

Physical factors in the environment are made up of non-living things and energy.

Ask the children to think for a minute and name the physical (non-living) factors that affect a plant community.

They should mention water, air, soil, temperature, and light.

The study of ecology is said to be the sum total of all physical and biotic factors that affect an organism.

Review Section B, Topic I, "Needs" with the children. Remind them at this point of the needs that are common to all living things, that is, air, water, light, food, and suitable temperature.

TEACHER'S NOTE: While all living things have the same basic needs, natural communities are based on the fact that among the many species of plants and animals that live on the earth, there is a difference in the amount air, water, food, light, and temperature that each species requires. Each species has a "range of tolerance" for each of the factors.

ACTIVITY 3: Discussing the Range of Tolerance.

Every plant and animal lives in an environment in which temperature, moisture, light, food, etc. occur within a range that permits it to live and grow. Goldfish can live and grow only within a temperature range of 32°F to 107°F. If the water is frozen (32°F) or warmer than 107°F for long periods, goldfish die. The *range of tolerance* for goldfish, then, is 32°F to 107°F. Goldfish grow most rapidly in the "optimum" range of 71°F to 87°F, as shown in Figure C-7. If any one of the environmental factors extends beyond the range of tolerance for the plant or animal it is called the *controlling factor*.

ACTIVITY 4: Determining Limiting Factors in Community Development

A forest or grassland community will be made up of plants and animals that are in a place where their physical needs are met (fall between the minimum and maximum range).

If the school grounds have any kind of plants growing, you may be able to show the children the plant community controlling factors.

A good way to start a school ground example of limiting factors and community development, would be to do the following:

Have the children go out on the school yard or ball field (any place where there is a grass lawn) and ask them the following questions:

Why are grassland plants the only plants growing here?

Can you find places on the school ground where grass is not growing because of a limiting factor?

TEACHER'S NOTE: The kinds of places to be looking for are areas under trees, ball field base paths, very stony or steep areas–any place at all where grass is not growing, but could if a condition were changed.

Ask the children what the limiting factors might be in the areas where no grass grows. The following list may be helpful.

Not enough light

Not enough water

Not enough soil

Too many people stepping on it

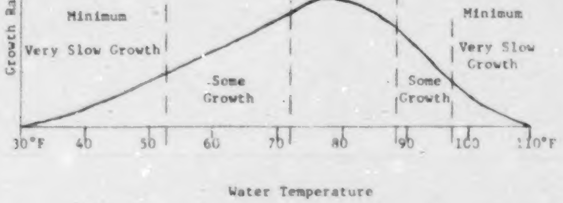
Ask the children what would happen to the grass if they left it alone. Would it get much higher and reach optimum growth? Point out to them that one of the limiting factors for grass is the lawn mower.

TEACHER'S NOTE: This concept will be discussed more fully in Topic IV, "Plant Communities Change."

EVALUATION:

Given the opportunity to define physical factors, children will demonstrate their awareness of the fact that physical factors are temperature, light, air, water, and other living things.

Given the opportunity to describe the meaning of the terms *range of tolerance* and *controlling factor*, children will demonstrate an awareness of the correct meaning of the terms and the relationship of the terms to the development of a plant community.



Range of Tolerance of Goldfish to Water Temperature

Figure C-7

FOREST PLANTS

GOALS: After this lesson children should:

Be familiar with the kinds of plants that make up a forest community.

Be able to distinguish between broadleaf and narrowleaf trees.

Understand the role of the understory plants.

Understand the structure of forest plants.

TEACHER'S NOTE: The identification of particular trees will depend on the local area and the information available. The activities suggested here are designed to help children learn the structural differences among the tree species.

ACTIVITY 1: Discovering the Upperstory

Forests are usually made up of two "story situations." The upperstory plants have one very important characteristic: they have the genetic ability to grow taller then their understory companions. For example, in some of the eastern oak forests the understory trees are dogwood and hophornbeam. These two trees would never grow as large as the oak even if they had ideal conditions.

Our effort here should be to help children understand the various parts of trees rather than to identify specific trees.

ACTIVITY 2: Discovering the Understory

Many forests have an understory community that is a combination of short trees, shrubs, wildflowers, ferns, mosses, and fungi.

If you are working in a woodlot, have your children explore the understory from ground level up.

Certain plants grow best in shady places rather than in full sun. Perhaps by observation you can discover some of these.

Give special attention to the discovery of plants that are non-green. Mushrooms and other fungi play a very important part in the forest cycle in that they are decomposers. They break down material and return it to the soil for reuse. We will discuss these plants further in Topic IV, "Plant Communities Change."

TEACHER'S NOTE: If you are working in a woodlot that is made up of coniferous trees (fir, pine) the understory may not be as pronounced as it is in a broadleaf forest but if you explore close to the ground you will find that there are a significant numbers of small plants that play a part in the forest community.

ACTIVITY 3: Learning the Parts of a Tree

A forest is sometimes referred to as a collection of trees. These trees provide many different kinds of products; they also provide the environment for soil and water conservation, for wildlife, for recreation, and for natural beauty. It is important that we know something about trees. There are many definitions of trees. In one, a tree is defined as a woody, perennial plant having a simple main stem or trunk with a more or less definitely formed crown and attaining a height of more than 20 feet. Like other living things, trees have interesting habits of growth and distinctive features which distinguish one kind from another.

In order to understand how a tree grows it is necessary to know the parts of a tree and their functions. In terms of tree growth there are three main parts: crown, trunk, and roots. See Master C-3.

The *crown* itself is the top of the tree. It consists of the limbs or branches which extend to the twigs and terminate with the buds. The leaves, flowers, fruits, and seeds are borne by the branches. It is within the crown portion of the tree that many of the vital processes take place which are responsible for growth and reproduction.

The *trunk* is the main stem of the tree. It supports the crown, serves as a pipeline for the flow of mineral solutions from the roots to the crown, and serves as a storehouse for foods – carbohydrates, fats, and sugars. When a tree is harvested, it is mainly the trunk in which we are interested.

The roots have four functions. They provide a base for the tree and serve as an anchor to hold the tree upright; they absorb water and dissolved minerals from the soil; they serve as a food storehouse, and they have different types of roots. Trees like spruces, hemlock, and white birch have shallow or surface roots which make them vulnerable to windstorms. Other trees like the oak, walnut, and hickory have a central deep-penetrating root, called a tap root, making them very resistant to wind damage. The third and largest group of trees have extensive root systems with both shallow roots and deep roots like tap roots.

ACTIVITY 4: Becoming Acquainted with Leaves

Leaves. Leaf characteristics which may be used in identification of trees include kind, shape, arrangement, size, type of apex, type of margin, and leaf composition. Figure C-8 shows the parts of a leaf. Leaves are of different kinds. The conifers have needle-like or scale-like leaves. Broad-leaved trees have either simple or compound leaves. Simple leaves consist of one piece while compound leaves are those that are divided into three or more sections called *leaflets*.

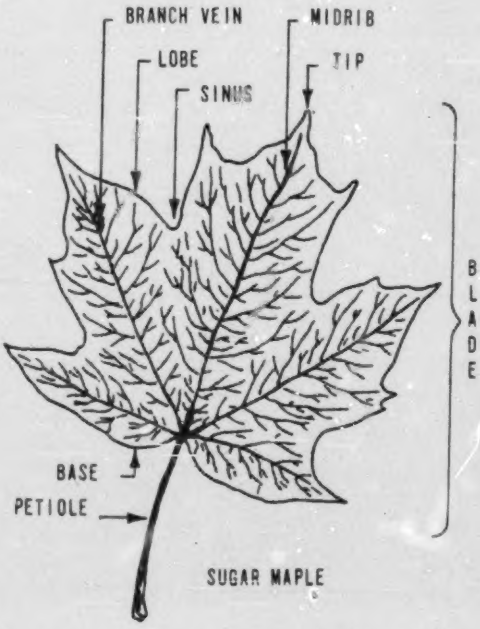
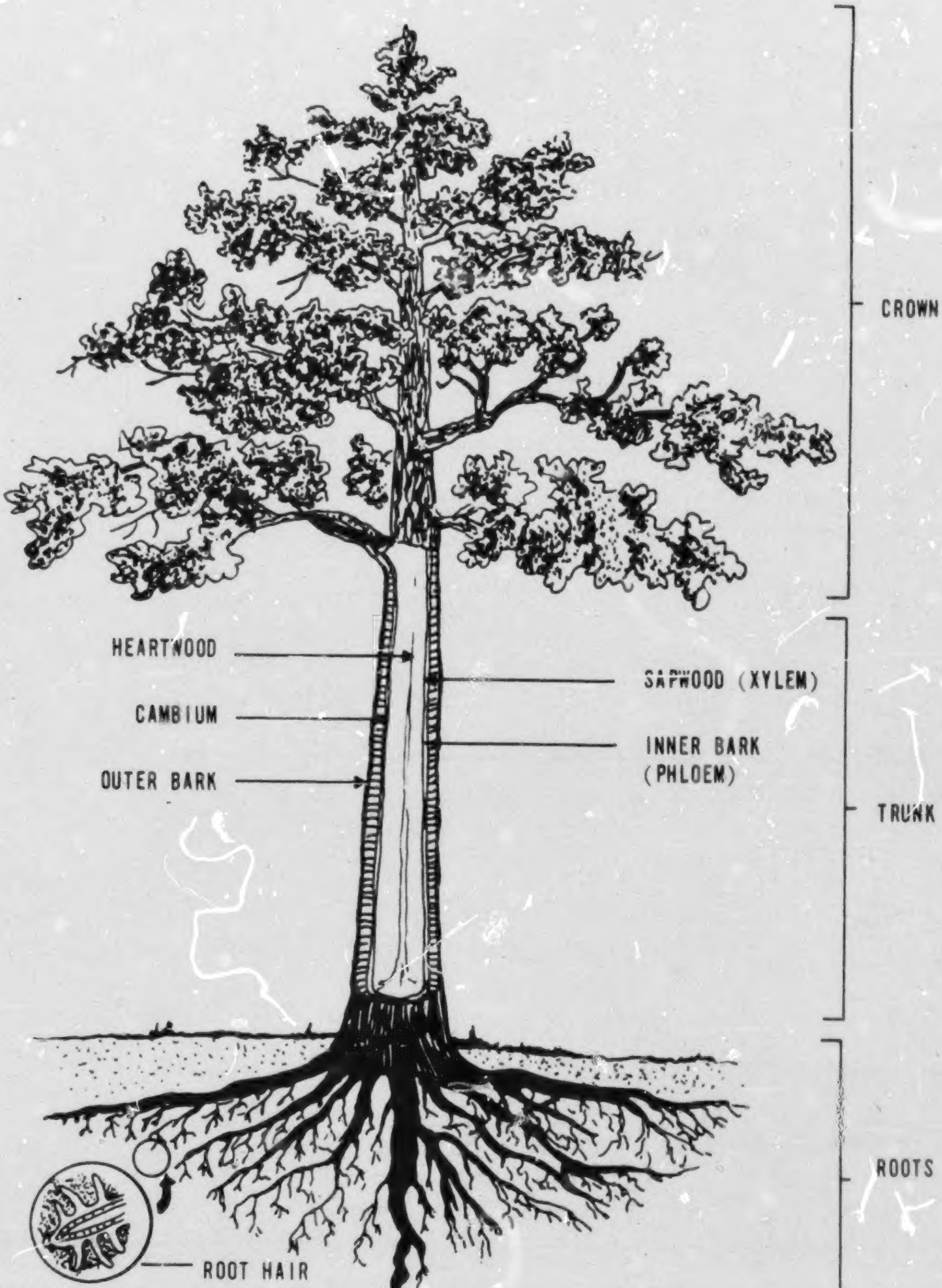


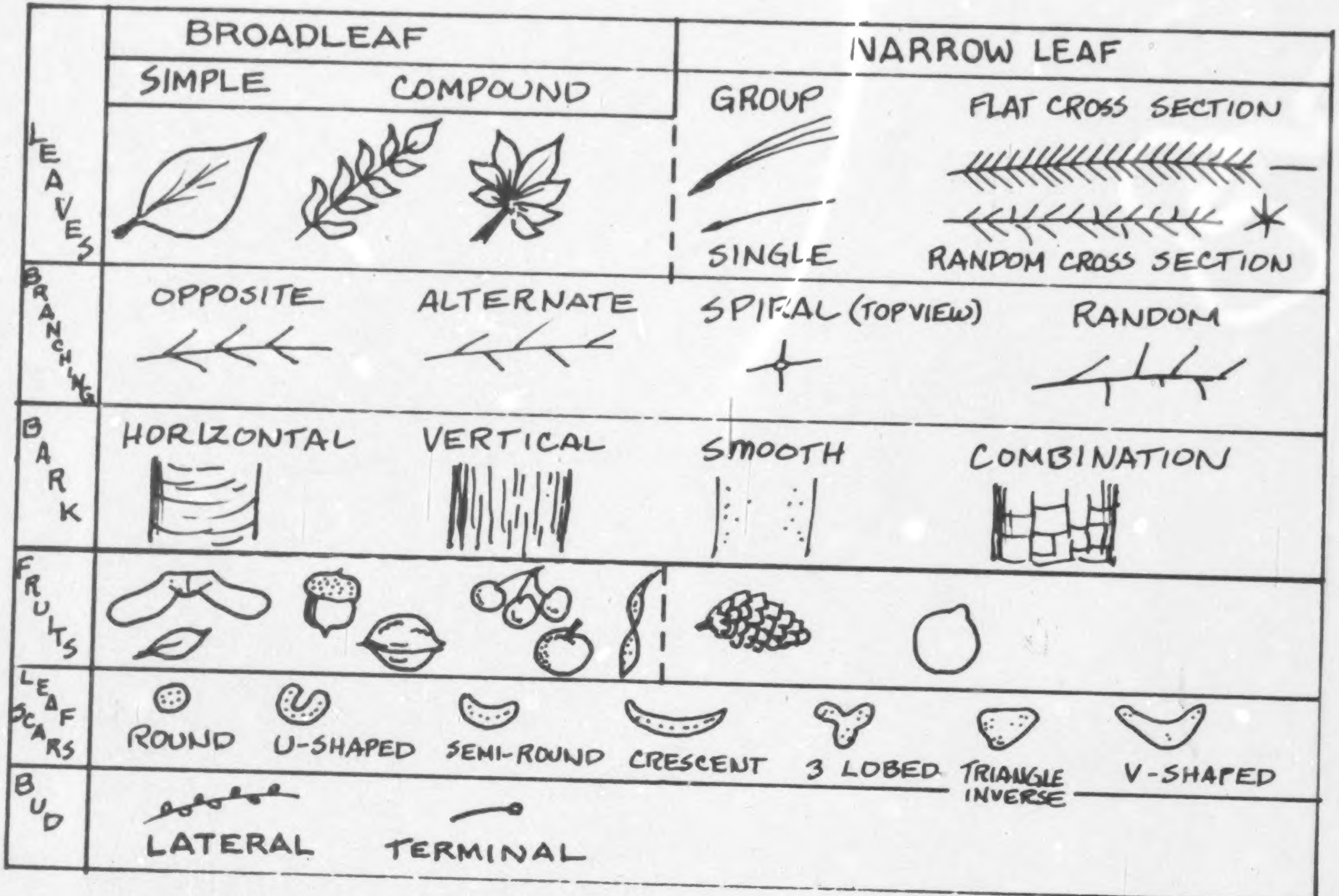
Figure C-8

MASTER C-3


CROWN
HEARTWOOD
SAPWOOD (XYLEM)
CAMBIUM
INNER BARK (PHLOEM)
OUTER BARK
TRUNK
ROOTS
ROOT HAIR
TAPROOT

WORKSHEET C-1

Use as a guide to become familiar with the parts of a tree.


BROADLEAF
NARROW LEAF
SIMPLE
COMPOUND
GROUP
FLAT CROSS SECTION
SINGLE
RANDOM CROSS SECTION
LEAVES
BRANCHING
OPPOSITE
ALTERNATE
SPIRAL (TOPVIEW)
RANDOM
BARK
HORIZONTAL
VERTICAL
SMOOTH
COMBINATION
FRUITS
LEAF SCARS
ROUND
U-SHAPED
SEMI-ROUND
CRESCENT
3 LOBED
TRIANGLE INVERSE
V-SHAPED
BUD
LATERAL
TERMINAL

ACTIVITY 5: Examining Trees

Using Worksheet C-1, have the children explore an area near the school where there are tall trees growing.

The main objective here is to have the children become familiar with the parts of the tree. They do not have to compare one tree to another, but it will be a much better experience if they can see that all trees, no matter what kind, have certain similar parts.

EVALUATION:

Given the opportunity to describe the various parts of the trees observed in the forest, children will be able to distinguish among: simple and compound leaves, horizontal, vertical, and smooth bark, opposite and alternate branching, lateral and terminal buds, cones and other fruits. If given the opportunity to observe forest plants, children will be able to categorize plants as belonging to the upperstory or the understory.

Given the opportunity to observe a forest or a picture of a forest community selected by the teacher, the children will be able to distinguish between broadleaf and coniferous forests.

Section C - Plants

Topic III

GRASSLAND PLANTS

GOALS: After this lesson children should:

Understand that there are certain areas in our country and the world where, because of low rainfall, grasses grow well, but very few trees grow.

ACTIVITY 1: Exploring Grassland Areas

After an exploration of forest plants in Topic II, take the children out to the school yard or any grassy area and ask them the following questions:

What is the basic difference between the plants we see here and the ones we observed in the forest?

Could trees grow here if we did not mow the grass?

TEACHER'S NOTE: The answer to the last question will depend upon the kind of area where you live. If you live in one of the prairie states, the answer may be no. If you live in a state where trees grow all around you, the answer will be yes.

How many different kinds of plants can you find growing in that yard?

Using the Exercise which follows, have the children do a study of the school yard or any grassland that they have access to.

TEACHER'S NOTE: The use of the 10,000th Acre Hoop is applicable to many different situations. As the children become familiar with it as a tool for study, you may apply it to any natural area that your students are working with. The real advantage of this kind of study is that it breaks numbers down into quantities that are easy for children to comprehend.

Encourage the children to include anything that they find within the hoop.

After the children have explored a grassy area, ask the following questions:

How many different things make up the grassland community?

How many different plants did we discover in the grassy area?

Were any other kinds of life discovered?

ACTIVITY 2: Places Where Only Grass Will Grow

Using an overhead transparency made from Master C-4, explain to the children that there are certain places in the country where only grass will grow instead of forests or desert.

Ask the children if they can figure out some of the reasons for this being true.

ACTIVITY 3: Discovering the Relationship Between Grasslands and Rainfall.

Using the rainfall map on Master C-5, make a transparency and lay it over the vegetation map on C-4. Point out to the children that one of the conditions required for a forest is at least 20 inches of rainfall per year. If this does not occur you are going to have grass, but no trees. Note how the grassland areas of the United States receive less than 20 inches of rainfall annually.

TEACHER'S NOTE: Be sure to tell the children that rainfall is not the only factor that determines grassland or forest growth, but is probably the most important one. The comparison of different maps as in steps 3 and 4 is a very good way to help children to discover many relationships that exist between living communities and physical environmental factors. Encourage projects of this nature with the children.

EVALUATION:

Given the opportunity to describe the "grassland" that they explored, children will, by their comments, demonstrate an awareness of the fact that grasslands are made up of a number of different kinds of non-woody green plants.

When asked why certain parts of our country are covered with grassland and not forests or deserts, or children will demonstrate by their answers that they are aware of the fact that rainfall of over 20 inches per year is necessary for forest land.

EXERCISE

THE ONE TEN-THOUSANDTH OF AN ACRE HOOP

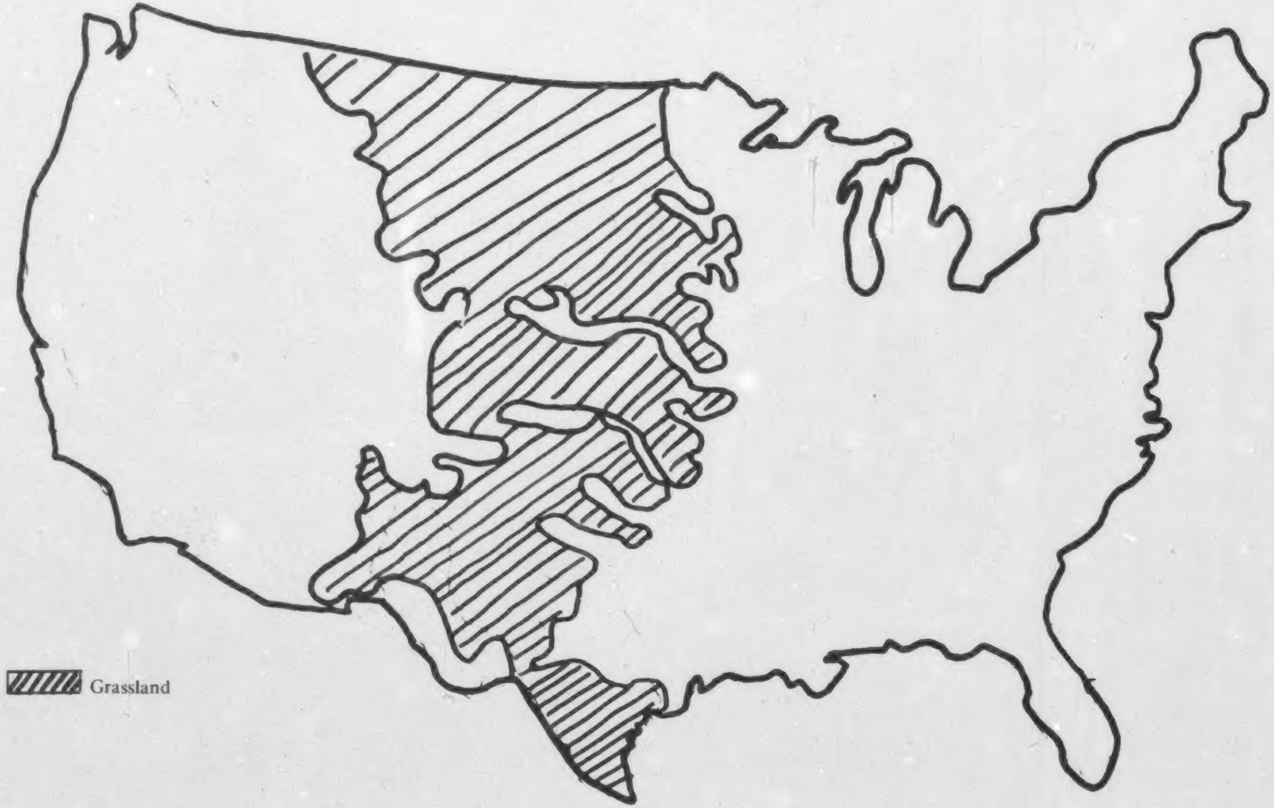
The use of the 1/10,000 of an acre hoop can be the starting point for lessons in various curriculum areas. Even the development of the hoop offers students the opportunity to learn the computation of the area, radius, and circumference of a circle.

If it is within the capabilities of the students, have them figure the area and circumference of one ten-thousandth of an acre. If 43,560 square feet is the area of an acre, then the area of 1/10,000 becomes 4.356 square feet. By using the formulas $A = \pi r^2$ and $C = \pi r$, the circumference of the circle can be figured. Therefore:

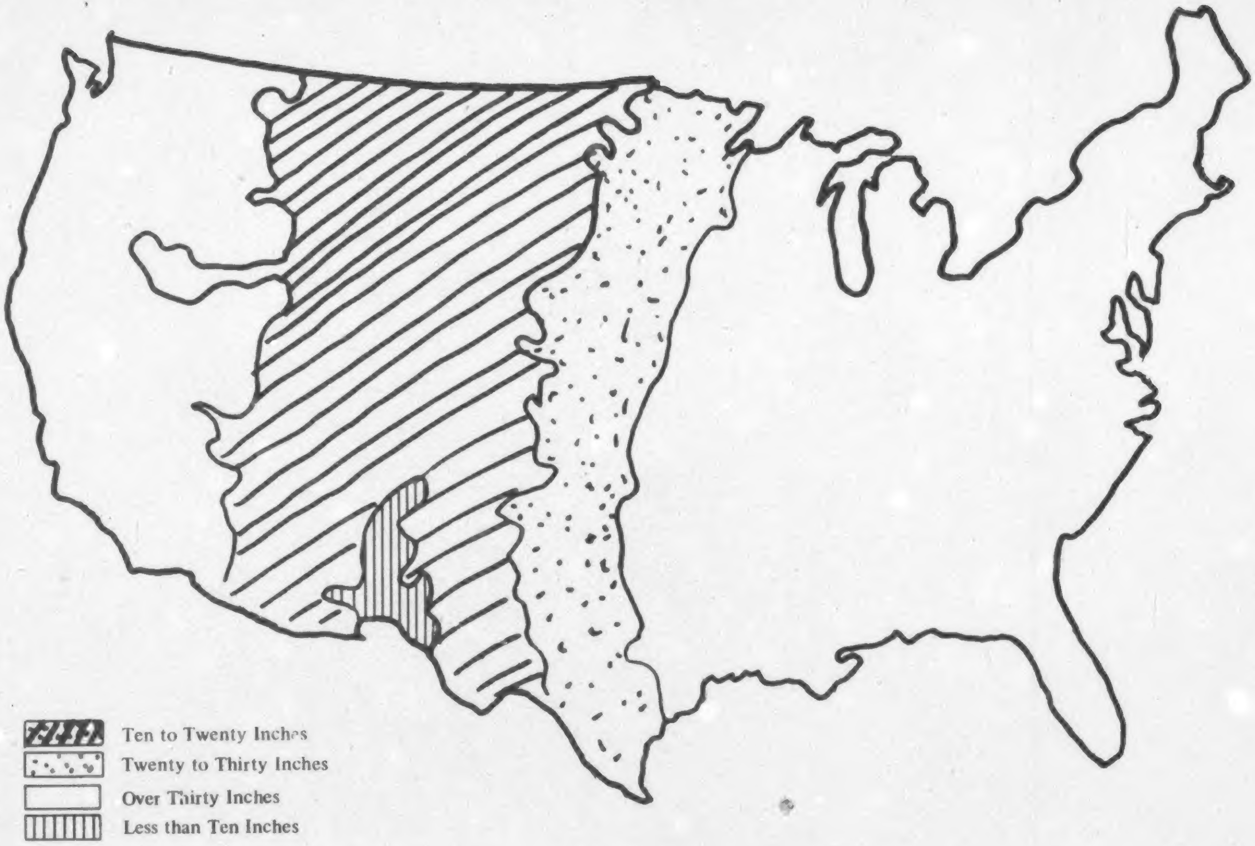
$$\begin{array}{rlcl}
A &= \pi r^2 & \quad & C = 2 \pi r \\
4.356 &= 3.14 r^2 & & C = 2 (3.14r) \\
1.387 &= r^2 & & C = 6.28 (1.17771) \\
1.17771 &= r & & C = 7' \, 3.96'' \text{ or } 88\ 3/4''
\end{array}$$

Lengths of clothes line wire can be cut to 88 3/4" and taped in a hoop. (Add an extra inch for overlap.) This circle can then be divided with twine into four quadrants.

MASTER C-4



MASTER C-5


▨ Ten to Twenty Inches
⁘ Twenty to Thirty Inches
☐ Over Thirty Inches
▥ Less than Ten Inches

ECOLOGY AND PLOT STUDY

For a general survey of an area, divide the class into groups of five. Have the students toss their hoops on areas of the school grounds or in a park. With a student working in each quadrant and one recording the information, have them count the number of things they find. At this time it is not necessary to identify everything by name. Interest should be in numbers and varieties. Vegetation, animate, and inanimate items should be all counted and classified. Later the class can compile and compare their samplings.

MATHEMATICS

After tallying all the numbers of plants, animals, insects, and non-living things, have the students project the number of varieties in an acre. Each group should total the four quadrants in their hoop and add four zeros. This would be the total for the acre if their hoop was exactly representative of the area. To get a more accurate picture, have the groups add all their totals, divide by the number of groups and add four zeros to each kind of thing found.

To aid the students in understanding the size of an acre, have them stand on the 90 yd 27 inch line of a standard football field. The larger part of the field is equivalent to an acre. (A=lw; A=90 3/4x53 1/3 yds; A=4,840 sq. yd. or one acre). Consider the Louisiana Purchase in which approximately 82,762,880 square acres of land was purchased for $15,000,000 or about 18 cents per acre. Compare this cost with an acre of land in your area now. What is the percent of difference?

LANGUAGE ARTS

Two areas of language arts which can be developed here are accura reporting and creative writing. Recording the data collected fro the count and reporting them to the class demands accurac Descriptions of the various items found in the hoop must complete enough to identify later.

Creative compositions and tall tales can be written about the a examined. A blade of grass telling why he is taller than the rest snail shell telling his life's story, or an acorn reflecting on t different directions his life might take are some of the ideas whi may arise.

CONSERVATION

To demonstrate the problem of litter, have the students toss th hoops in a littered area around the school ground and have the pick up every scrap of trash in the circle. The trash can be weigh and the projected total of the amount of litter in the school groun can be made. A weekly cleanup of a given area can lead to a yea projection of litter accumulating just on the school grounds. Wh does it cost the school, town, and state for litter cleanup annuall

As a graphic demonstration of how bad litter can be, secu permission to display the litter in the school lobby or a display ca

To demonstrate what litter can do to water, place the trash fro one quadrant in a gallon jar partially filled with water. Close the j and open it again after three days, a week, ten days and two wee What do the contents of the jar smell like each time? What physi changes have occurred in the litter? the water? What relevance do this have to the rivers and lakes that are now dying?

Section C - Plants

Topic I

PLANT COMMUNITIES CHANGE

GOALS: After this lesson children should:

Be aware of the natural processes of heredity and succession that cause changes to occur in plant communities.

Understand that the climax vegetation in a given area is dependent on the growth potential of a plant and the physical factors that surround it.

ACTIVITY 1: Becoming Familiar with the Concept of Heredity

Explain heredity to your children in general terms. They should understand that like produces like within a plant species.

Oak trees produce oak trees, not pines.

Part of this explanation should include the point that even though heredity means the reproduction of one of the same species, the offspring may be slightly different from its parents.

The above point can easily be made by having children recall the similarities and differences between them and their parents.

Ask them: How are you and your parents alike or different?

Our major point in the explanation of heredity and its relationship to plant community change is this: *Heredity* determines the maximum development that a plant *can* attain.

Heredity and the physical factors that surround a plant determine the maximum growth it *does* attain.

In other words, once an egg is fertilized it has a particular growth potential and range of tolerance potential that are dependent upon each other. If the seed is planted in an environment where all physical factors are ideal, it will reach its full growth potential.

This growth potential-physical factor relationship is the basis f plant community change.

ACTIVITY 2: Discussing Plant Succession

Plants in a community compete for those physical factors th they all need.

Plant communities change as new plants that have a grea growth potential are introduced.

The following explanation combined with the use of an overhe transparency made from Master C-6 will help to introduce pl succession or change.

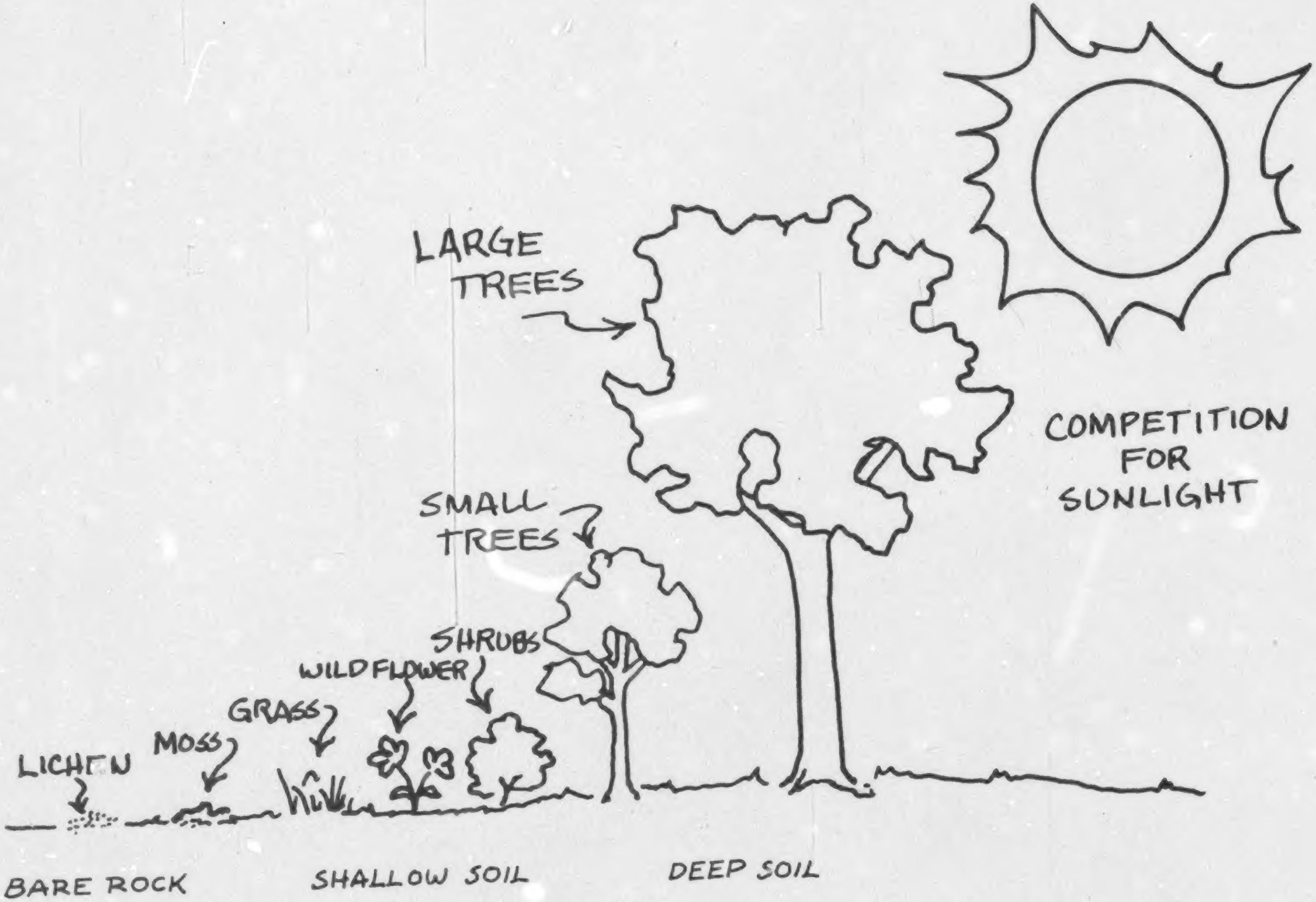
Stage A: Soil conditions are bare rock, no plants growing, b weathering is taking place and the rock is being broken do into soil parent material. (See Soil Formation, Topic II, Soil.)

Stage B: A very small plant called a *lichen*, which is combination of an alga and a fungi, has its spore blown in by wind and it starts to grow on the rock. The lichen can actua exist with very little soil and it gives off a very weak acid t helps to break down the rock further into soil parent material.

Stage C: As the parts of the lichen die and start to decay t add organic matter to the soil parent material and soil starts form.

Stage D: Seeds and spores from many kinds of plants are blo in and land on the new soil and start to grow and replace lichen.

Stage E: The mosses do not need much sunlight but do n moist conditions so they grow before any of the larger pla


LARGE TREES
COMPETITION FOR SUNLIGHT
SMALL TREES
SHRUBS
WILDFLOWER
GRASS
MOSS
LICHEN
BARE ROCK
SHALLOW SOIL
DEEP SOIL

They grow, die, decay, and form a deeper soil, one that will support higher plants.

Stage F: Grasses and wild flowers start to grow in the soil formed by the lichen and the mosses, and because the grasses and flowers can grow larger than the mosses and lichens they deprive the smaller plants of sunlight, moisture, and minerals, and soon become the predominant plant.

Stage G: Grasses and wild flowers grow, die, and decay, adding to the soil formation (remember that the rock is still being weathered).

Conditions become favorable for the growth of seeds of certain kinds of shrubs.

Stage H: Shrubs are larger than grasses and wild flowers so they crowd out the smaller plants and become predominant.

Stage I: Shrub leaves fall to the ground and add to the soil formation which has now become much deeper and will support larger plants.

Stage J: Seeds from larger trees then grow and crowd out the smaller trees, and shrubs.

Climate Stage: When a plant community reaches the stage where the plants with the largest growth potential are mature and predominate in the community then we have a *climax forest.* (In the case of grassland, the climax vegetation is grass).

TEACHER'S NOTE: The above explanation of how a plant community changes is very real, but the stages are not as well defined in nature as they are on these pages. Any one stage may last for a very long time, until the physical factors change and way is made for the next stage.

If, for example, the physical factors were ideal for the grass s
and did not change we would have grass but no trees as discu
in Topic III, "Grassland Plants."

ACTIVITY 3: Discovering Examples of Plant Succession

One of the best ways to see plant succession in action is to fe
off a section of the school yard and just observe it over a pe
of years. This may be difficult to do but it would afford you
the children an opportunity to observe plant succession
changes in the plant community on a continual basis through
their time in elementary school.

Forest and Field Edges

If your school has land that is bordered by woods or fields
you can persuade the custodian not to mow the grass so clos
the edges, you will have an excellent place to observe chang
plant communities.

Almost any area that is left alone for a period of a month
more during the growing season will show evidence of cha
Seek these areas out and you will be able to offer your childr
very good discovery experience.

EVALUATION:

Given the opportunity to give reasons for plant sizes, child
will demonstrate an awareness of the role that heredity
environmental factors play in determining plant size.

Given the opportunity to discuss plant succession, children
demonstrate an awareness of the following:

Plant succession depends upon heredity and environme
factors.

Plant succession occurs in steps or stages as shown in Acti
2.

Section C - Plants

Topic

GREEN PLANTS MAKE FOOD

GOALS: After this lesson children should:

Understand the food making process in green plants.

Understand the structure of plants and the relationship of this structure to the food making process.

ACTIVITY 1: Studying the Structure of Plants

Review the human processes of absorption, digestion, respiration, support, circulation, and protection with the children. Point out to them that plants depend on the same processes, but their structure and method of doing things is a little bit different.

The following analogy has been used successfully to explain the structure of plants to children. It is based on a comparison of human structure and process to plant structure and process. Make an overhead transparency from Master C-7 to help explain plant structure. You can also use the real parts of plants if they are available.

Each stage of the explanation should be preceded by a question about the human body.

How do we breathe?

We breathe by taking air into our mouth and nose. Plants do not have a nose, but they do have many tiny mouths in their leaves.

Each mouth is called a *stomate*. Stomates are openings that
guarded by two semicircular cells that open it in the daytime
close it at night.

Air comes into the plant and is stored in the *air spaces* until
used. This is very similar to our *lungs.*

We will later see how the air is changed in the leaf. After
changed it goes back out through the stomates.

How do we drink?

We take water in through our mouth and it goes to our stom
The plant takes water in through its root hairs, but the w
must reach the stomach of the plant. Ask the children to
thinking about where the plant's stomach might be.

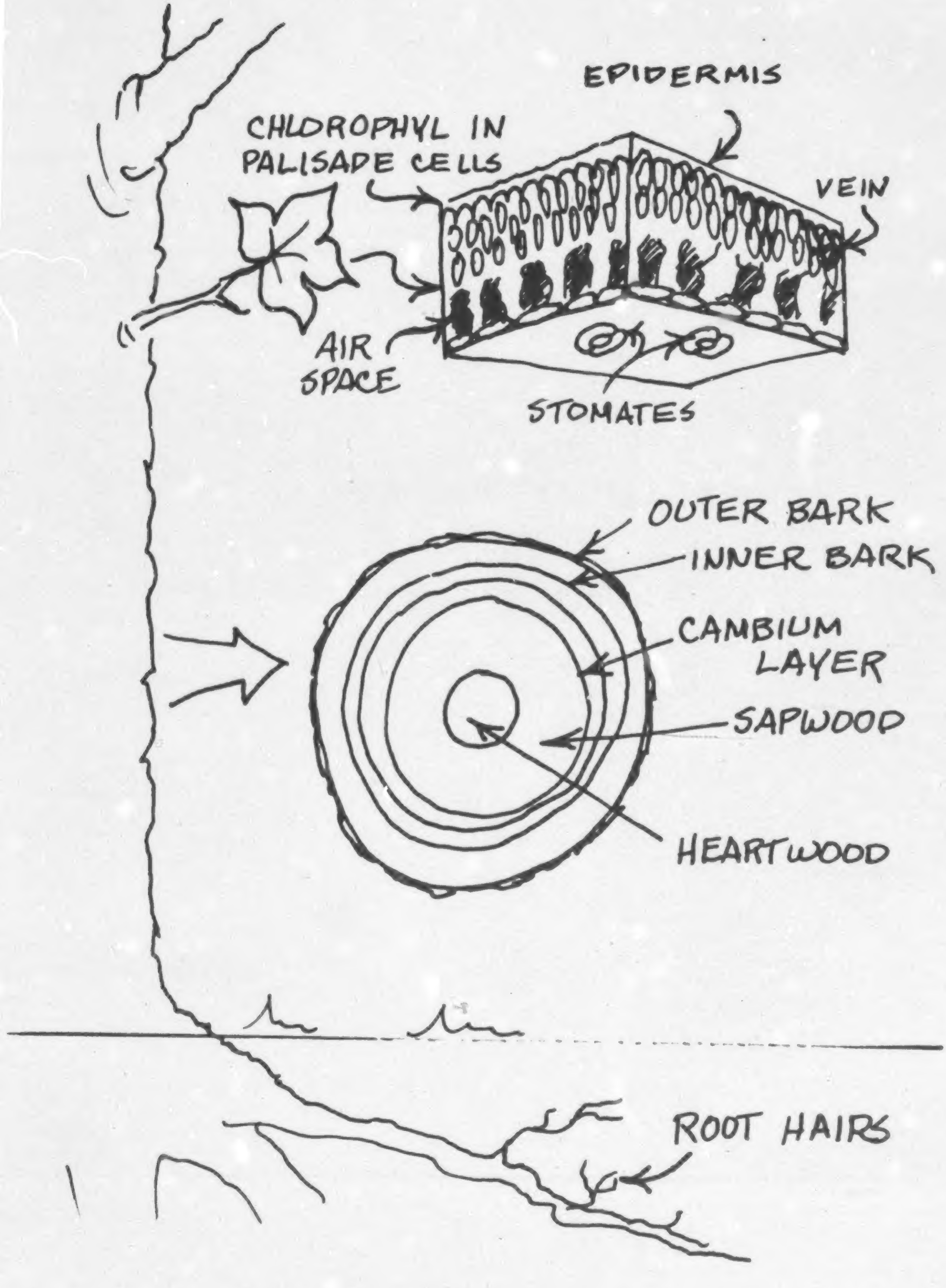
How does our body transport fluids?

We have a series of arteries and veins that carry material aro
in our bodies. The tree has structures that do this also. Thr
a process called *transpiration,* water is carried through the
in the *sap wood* up to the leaves of the tree. Food material
by the tree is carried from the leaves downward through
inner bark.

How does our body grow?

Our body grows by a process called *cell division*. The same
is true in the tree. In a tree the *cambium layer* is where

MASTER C-7


EPIDERMIS
CHLOROPHYL IN PALISADE CELLS
VEIN
AIR SPACE
STOMATES
OUTER BARK
INNER BARK
CAMBIUM LAYER
SAPWOOD
HEARTWOOD
ROOT HAIRS

growth occurs. Cells on the inside of the cambium layer turn into heartwood while those on the outside turn to sap wood. Cells on the outside of the sap wood turn to inner bark and cells on the outside of inner bark turn to outer bark. The tip of each stem also is a place where cells divide, but in this case new stems, leaves, and flowers are produced.

What supports our body?

We get our support from bones and muscle. The tree gets its support from all over. All of its woody cells support it and hold it upright.

How is our body protected?

Our bodies are protected by a covering of skin. Trees also have skin called *outer bark*. The outer layer of cells of leaves is called the *epidermis*, just as our outer layer of cells (our skin) is also called our epidermis.

How do we use food?

We take food into our bodies and it is digested in our stomach and intestines. The tree actually makes food and uses only a part of it.

ACTIVITY 2: Learning How a Tree Makes Food

We have discussed the way materials enter the tree. Water com in through the roots and air comes in through the leaves. T following formula shows how a tree combines water and carb dioxide to produce the basic food sugar plus oxygen.

$$6H_2O + 6CO_2 \rightarrow C_6H_{12}O_6 + 6O_2$$

water — carbon dioxide — sugar — oxygen

This occurs in the palisade cells of the leaf, which contain t green material, chlorophyl. In the presence of sunlight, chl rophyl carries out this chemical reaction called *photosynthes*

EVALUATION:

Children can describe how a plant (tree) carries on life process and can demonstrate an awareness of the function served by t parts of a tree and a leaf shown on Master C-7 and described the questions in Activity 1.

Children will be able to demonstrate their knowledge of the f that CO_2 from air and water from the soil combine in t presence of sunlight and chlorophyl to produce sugar and gi off oxygen.

Section C - Plants

Topic V

PEOPLE WHO MANAGE OUR FORESTS AND GRASSLANDS

GOALS: After this lesson children should:

Be aware of occupations that exist in the areas of forestry and grassland management.

Understand the nature of the work tasks performed by forestry and grassland workers.

Appreciate the needs that would be met by work in forestry and rangeland management.

Be aware of how one goes about preparing for such work.

ACTIVITY 1: Discussing Occupations in Forestry

The forests of our country are a very important natural resource. They provide wood for lumber, paper, and fuel. At one time our country was using trees more rapidly than new ones could grow to replace them. Now the harvesting of trees is being carefully limited so that young trees are replacing old ones as rapidly as the older ones are harvested. Some areas of woodland in which trees have never been cut are being preserved so many generations of people can see what the forests of our land originally looked like. Tracts of Giant Sequoia and Redwood in California have been preserved for this reason. A *forester* is responsible for the proper management and protection of trees in a forest area. This individual determines how many trees can be cut each year; supervises fire protection and fire fighting; and plans replanting where needed. The forester often works with the game warden in protecting wildlife in a given area. A *forest technician* helps the forester by estimating the volume of lumber in a stand of trees, by making land surveys and maps, and by supervising the planting of seedling trees. Some forest technicians supervise fire protection and fire fighting crews. A *forester aide* works under the supervision of the forest technician, making actual measurements of trees, measuring land distances for surveys, recording weather information, planti seedling trees, and fighting forest fires.

ACTIVITY 2: Discussing Occupations in Grasslands

Grasslands are like forest lands except that the rainfall is le and this results in far fewer trees and much more grass a shrubs. These areas often receive no rain for periods of seve months. Areas that are drier than grasslands are dese Grasslands are suitable for raising cattle and sheep, provid there are not so many grazing animals in a given area that th eat the grass too close to the ground and it dies. Grasslands oft have wildlife that is hunted for recreation.

A *range manager* supervises the use of public grasslands. Sor private ranches may hire a person to do the same kind of wor the range manager determines how many grazing animals m use a particular area, protects the area from fire, provid watering places for the animals, supervises the replanting overgrazed or burned grassland, and regulates hunting.

A *range technician* keeps the range manager informed by maki surveys of the plants and animals in the grassland area (often airplane, because of the great distances involved) and supervi the work of *range aides* who fight fires, plant grasses, impro watersheds, and release or protect wildlife.

ACTIVITY 3: Interviewing Workers

Where this is feasible, have one or more students interview parent, relative, or close friend who is employed in occupation dealing with forests and/or grasslands. Have cl members discuss kinds of information and questions to a Following the interview, have the student identify the car explored, present findings and answer any questions th classmates may ask.

ACTIVITY 4: Preparing a Bulletin Board

Have each student cut out an illustration from a magazine or newspaper which shows forestry or grassland workers.

Group these pictures on a bulletin board so as to illustrate the many different occupations. Have students study and react to the display in class discussions.

EVALUATION:

The student can identify at least two occupations in forestry and two occupations in grassland management.

The student can state how forestry workers and grassland managers contribute to his well-being and the welfare of the community and nation.

Section C - Wildlife

Topic I

WHAT IS WILDLIFE?

GOALS: After this lesson children should:

Understand the difference between wild and domestic animals. Understand the fact that a wild animal's freedom is limited only by its ability to meet its needs without the interference of man.

Realize that wildlife must include all life other than human or domestic animals or plants.

Be aware of the divisions that exist in the animal kingdom.

ACTIVITY 1: Defining Wildlife

For our purposes, *wildlife* will be defined as any living thing that is not a human or domestic animal or a plant. Our emphasis will be on the vertebrates, but the interrelationships that exist in all areas of the animal kingdom will be discussed.

Wild animals have one distinct characteristic that may be used to distinguish them from the rest of the animal kingdom. Their whole structure and motivation is to move within their natural surroundings in order to meet their needs. The only limitations that are placed on wild animals are those that come from the natural environmental forces that surround them.

TEACHER'S NOTE: It will be helpful at this time to review the needs of all living things with the children, because the differences that will be pointed out among wild animals will be very relevant to how each kind meets its needs.

ACTIVITY 2: Learning About Divisions Within the Animal Kingdom

The animal kingdom is divided into groups that have similar characteristics. The first two divisions in the animal kingdom are *vertebrates,* those animals with a backbone, and *invertebrates,* animals with no backbone.

On Worksheet C-6, have the children pick those animals that they think have backbones, and those they think do not.

TEACHER'S NOTE: The animals shown on Worksheet C-6 are representatives not only of veterbrate and invertebrate animals, but also of the other divisions within the animal kingdom. If your science unit suggests that you give children more depth in the invertebrate classifications, this worksheet will help to introduce the unit. Our work with wildlife will be within the vertebrate division.

ACTIVITY 3: Becoming Acquainted with Divisions Within the Vertebrates

Vertebrates can be put into one of five groups. The following are brief descriptions of each group and may be used with pictures on Worksheet C-2, to help children understand the differences between the groups.

Mammals:

If an animal has hair and mammary glands, it is probably a *mammal.* Mammals also have the kind of teeth that enable them to eat a variety of foods. They have teeth that nip and chop (incisors), teeth that stab (canine) and teeth that grind (molars and premolars). The young of all mammals feed from the mammary glands of the mother.

Ask the children if they have seen a mammal lately.

Reptiles:

Reptiles can best be distinguished by two things: they have a skin that is made up of horny scales, and they have claws.

Amphibians:

Many amphibians resemble reptiles, but there are ways to tell the difference. Amphibians do not have scales. They usually have toes (sometimes the 5th toe is hard to locate). Amphibian young are always born in the water. Amphibians must always stay close to water because they have no way of preventing large losses of body water.

Birds:

Birds have feathers and hollow bones, both of which make them light enough to fly. Many birds have other adaptations to meet their needs, and these will be discussed in Topic V "Wildlife in the Air."

Fishes:

Simply stated, fishes all swim and can breathe under water. Again, we will take a closer look at fishes in our Topic III "Wildlife in or near the Water."

EVALUATION:

Given the opportunity to define wildlife, children will demonstrate a knowledge of the following facts:

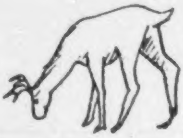
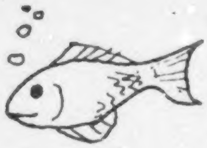
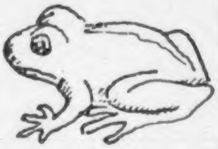
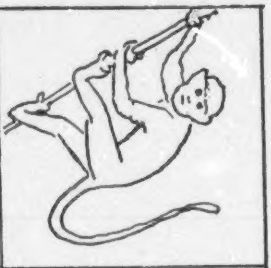
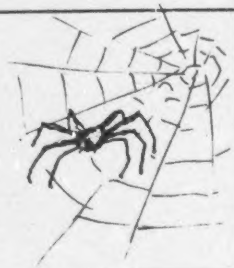
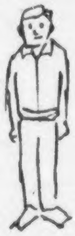
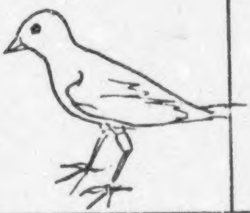
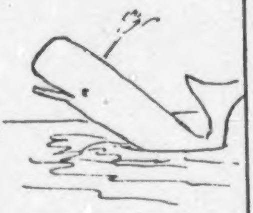
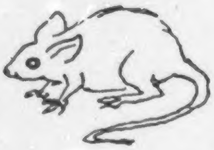
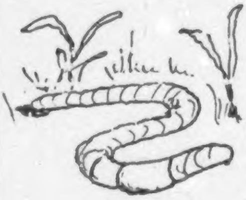
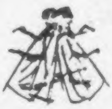
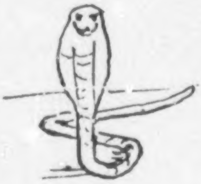
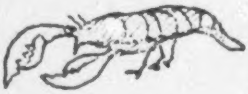
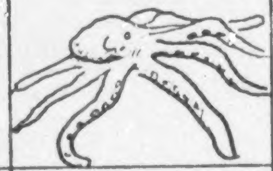
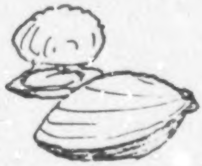
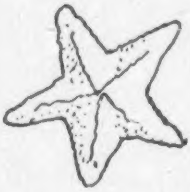
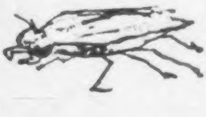
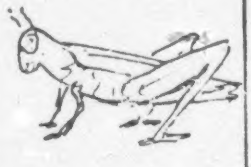
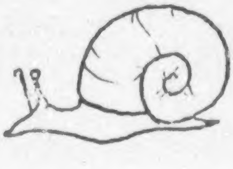
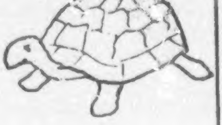
Wildlife is any living animal except humans and domestic animals, whose freedom is limited only by its ability to adapt to its surroundings.

All wildlife can be put into two study groups: those with backbones and those without.

Given the opportunity to name the five divisions of vertebrates, children will demonstrate a knowledge of the divisions (fish, reptiles, amphibians, mammals, and birds) and will be able to describe the general differences between them. as stated in Section V.

WORKSHEET C-2

Mark an (X) by each animal that has a backbone and a (O) by each animal that does not.

Section C - Wildlife Topic II

ADAPTATION

***GOALS:** After this lesson children should:*

Understand that the word *adaptation* means change.

Understand that the environmental forces that surround an animal will dictate the way the animal will change.

ACTIVITY 1: Discussing Change

If we did not have clothing to wear, how might our bodies change to protect us from the cold?

If we had to live in the ocean, what kind of changes in our bodies would be necessary?

Point out to the children that one of the reasons that the human animal is so unique is his ability to create artificial adaptations that allow him to live and move about in environments other than the one he was naturally made for.

Wild animals cannot do this. Thousands of years and many generations pass before true adaptation takes place. What happens to a species that cannot adjust to changes in its environment?

ACTIVITY 2: Discussing the Environmental Forces That Cause Change

Temperature:

Ask the children if they have ever noticed how the hair on their pet animals changes in length and thickness as the seasons change. Only animals that can do this can live in areas where the temperature changes significantly. How do birds change to meet their temperature needs? How about fish?

Food:

Most animals must move around in order to get food. Some animals have developed fins with which to swim, wings with which to fly, or legs for running and climbing.

Protection:

Have the children discuss the physical features that each of the following animals use for protection:

Elephant, squirrel, robin, snake, lizard, frog.

Why are polar bears white? How well would a black bear do in snow country? How about frogs and toads? Does their color often match their surroundings?

What would happen if all of the animals in the world suddenly lost their ability to protect themselves?

TEACHER'S NOTE: The above are but a few of the forces that combine to cause changes in animal development. Point out to the children that environmental forces act in combination to effect changes in animals, and that these changes take place very slowly over a very long period of time.

EVALUATION:

Given the opportunity to define adaptation, a child will demonstrate his awareness of the fact that adaptation is change brought about by the environmental forces that surround a species of animal.

Section C - Wildlife Topic III

WILDLIFE IN OR NEAR THE WATER

GOALS: After this lesson children should:

Understand that the animals that live in or near the water are usually amphibians and fishes.

Understand the physical structure of fishes and amphibians that allows them to live in or near the water.

ACTIVITY 1: Discovering How Fish Swim

Fishes and amphibians are all very good swimmers. Swimming is their natural form of movement.

The explanation of fish movement can be made easier by the use of an overhead transparency made from Master C-8.

Have the children observe fish in a pond or goldfish bowl, and ask the following questions:

How does the movement of fins enable fish to swim?

What particular job does each kind of fin do?

TEACHER'S NOTE: The caudal fin helps the fish to steer and brake. It also gives forward motion. Dorsal and anal fins help to keep the fish in an upright position much the same as the keel of a boat or the vertical stabilizer on an airplane. The pectoral fins move the fish forward on backward, move as well as upward or downward.

What do you think enables the fish to stay at a particular up/down level in the water?

TEACHER'S NOTE: Fish have a *swim bladder* in which they can adjust the amount of air to avoid either floating to the surface or sinking to the bottom. Submarines adjust the air pressure within them for the same purpose.

Demonstration of a swim bladder:

Put a small plastic bottle with no water in it, and with the top closed tightly, in a container filled with water. Have the children observe the floating bottle and then add small amounts of water to the bottle until it will float somewhere in the middle of the water. This point is difficult to obtain–the bottle will nearly always slowly rise or fall. Add more air and the bottle will rise. Add more water and the bottle will sink.

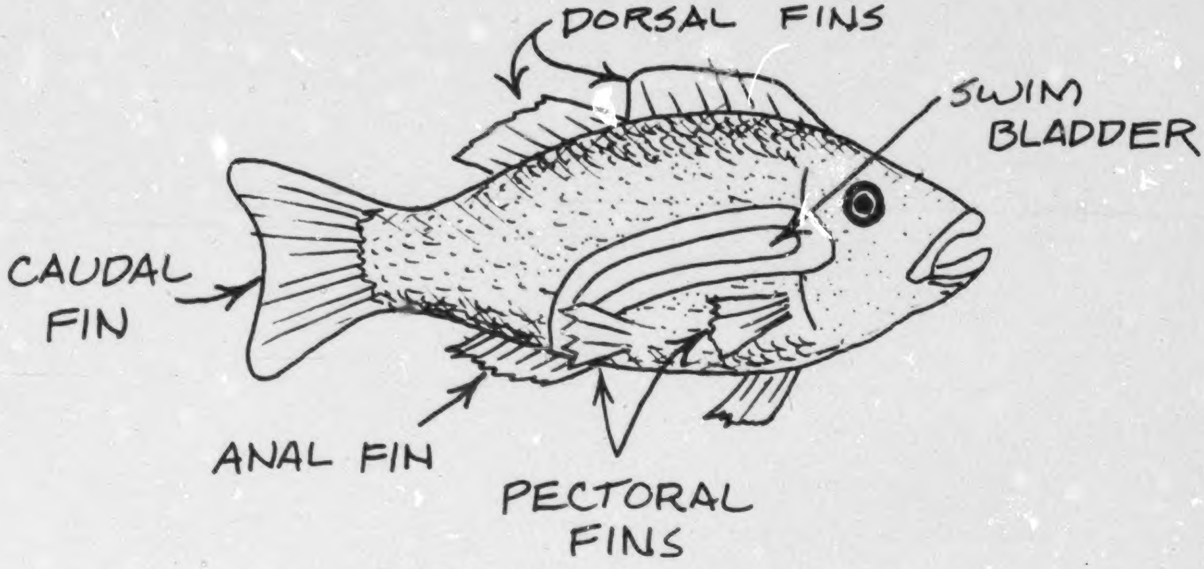
ACTIVITY 2: Learning How Fish Breathe

We know that all living things need air. The fish has a particular organ called the *gill* that enables it to separate air from the water and use it for respiration and to control the swim bladder.

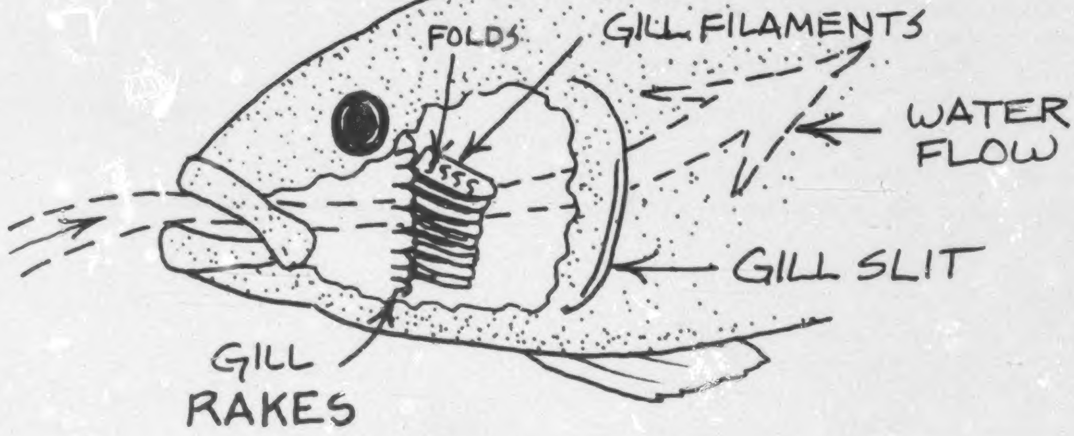
The bottom of Master C-8 may be helpful in explaining the breathing structure of fish to children.

Water comes into the mouth and then flows over the gills and out the gill slit. Capillary beds are located in the gill folds. As the water passes through the gill folds, oxygen is taken out of it

THE PHYSICAL PARTS OF A FISH THAT ENABLE IT TO SWIM.


DORSAL FINS
SWIM BLADDER
CAUDAL FIN
ANAL FIN
PECTORAL FINS

THE PHYSICAL PARTS OF A FISH THAT ENABLE IT TO BREATHE.


FOLDS
GILL FILAMENTS
WATER FLOW
GILL SLIT
GILL RAKES

because the oxygen concentration in the blood is less than in the water. (Remember, oxygen will move from areas of high to low concentration.) Carbon dioxide, CO_2, is higher in the blood than in the water so it leaves the blood, goes into the water, and then out the gill slits.

Food is removed from the water by the *gill rakes* that are connected to the esophagus and allow the collected food to go into the digestive system.

ACTIVITY 3: Learning About Amphibians

Frogs and salamanders are examples of amphibians. They spend part of their life in the water and part of it on land near the water.

An amphibian must reproduce in the water. Ask the children what this means regarding the physical characteristics of the young? How would they breathe? How would they move?

Metamorphosis is a very good example of animals adapting to their surroundings.

In the spring get some frog eggs from a local pond or stream and put them in an aquarium so the children can observe first-hand the metamorphic change in amphibians.

In most fresh water ponds in the spring, tadpoles should be very easy to catch and bring inside for observation.

The diagram and explanation on Master C-9 will help guide the children's observation.

ACTIVITY 4: Discussing the Importance of Clean Water to Fish and Amphibians

In Section C-Air, Topic I, "What is Atmosphere?" air is about 21 percent oxygen. When a land animal breathes he has this much to use.

The amount of oxygen that dissolves in water, however, is only 1 percent. If the water became dirty and the 1 percent oxygen was used for decomposition, fish and amphibians in the first stages of life could be in trouble. Waters must be clean and free of oxygen-robbing dirt.

ACTIVITY 5: Learning About Other Animals That Live in or Near the Water

Master C-10 shows many pictures of animals that are neither fish nor amphibian, but do live in the sea. Some of these may be observable in your area. Help the children to discover the special body structures evident in each picture that enable the animals to live in the water.

EVALUATION:

When asked the question "What kind of vertebrate animals are well suited for life in the water?" children will respond with the answer, "Fishes and amphibians."

When asked why fishes and amphibians are well suited for life in the water, the children will give answers that demonstrate their awareness of the importance of gills, swim bladder, and fins for a life in the water.

Section C - Wildlife Topic IV

WILDLIFE ON LAND

GOALS: After this lesson, the children should:

Be aware of the particular characteristics of land animals that enable them to survive.

Be familiar with the wild animals that live in their area.

TEACHER'S NOTE: This topic will be very general, and will depend on the kind of land animals that might be found in your area. The purpose will be to help the children discover the many forms of wildlife that surround them.

ACTIVITY 1: Gathering Information About Wildlife

Ask the children to tell the kinds of wild animals they have seen in their area and make a list of them. When the list is complete, assign the children the task of gathering pictures and information about those animals.

Some guidelines for information gathering.

What is the animal called?

How does it move?

What does it eat?

What kind of body covering does it have?

How does it protect itself?

In what surroundings is it usually found?

Are there any special characteristics that help the animal get along well with its surroundings?

ACTIVITY 2: Developing a Bulletin Board

Have the children develop a bulletin board that shows the animals that live in their area and give information about each one.

ACTIVITY 3: Interview Resource People

Many state game commissions have excellent resource people who are willing to come and talk to school children. Contact the local Game Commission and inquire about this service.

A visit from a resource person will give the children the opportunity to ask questions that they have developed in Activities 1 and 2, but on which they could not find information.

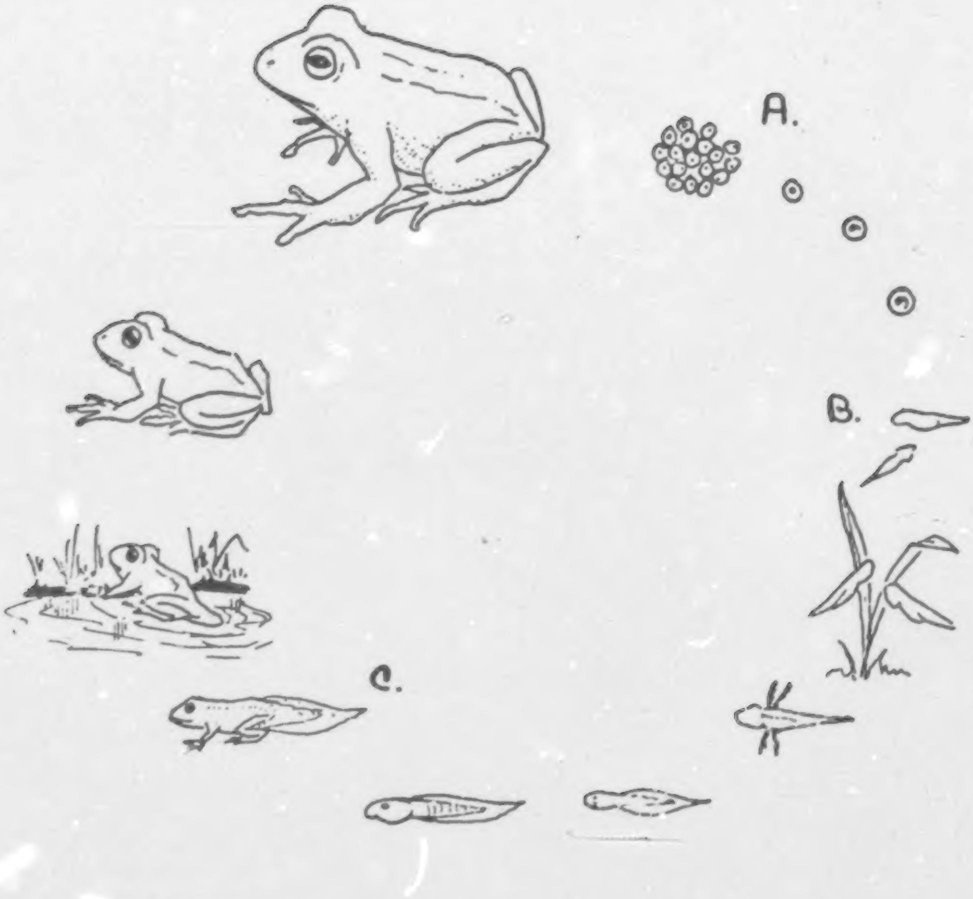
EVALUATION:

Children will demonstrate the following to the satisfaction of their teacher:

A knowledge of the kinds of land animals that live in their area.

The ability to answer the questions in Activity 1 for several animals in each of the divisions: mammals, reptiles, birds.

MASTER C-9

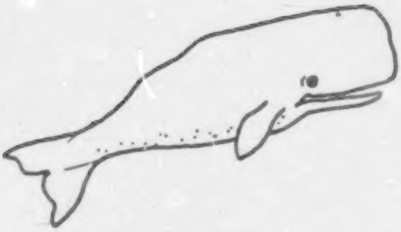


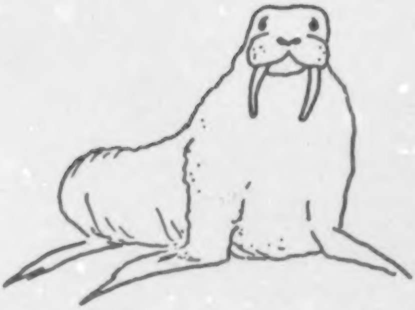
A. Egg stages.

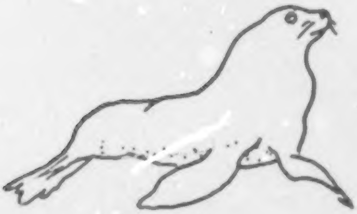
B. In 10 to 14 days the tadpole emerges from the egg.

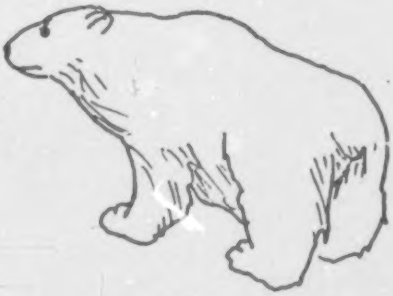
C. In 2 to 3 months the front legs come through, gill and gill slits are lost and the tail absorbed. Teeth are lost, the tongue develops, eyes and ears change for land use, and the young frog start~~s h~~is life on land and lily pad.

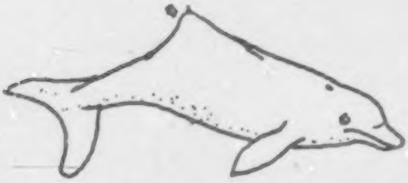
MASTER C-10

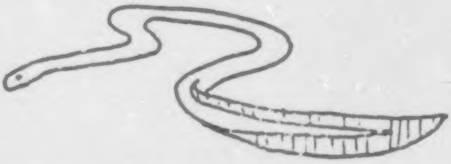


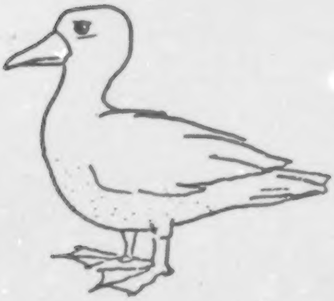


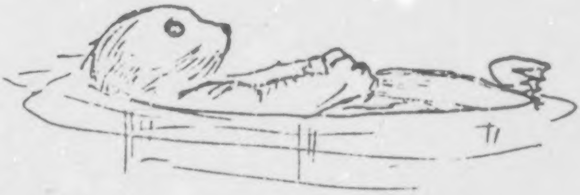












Section C - Wildlife

Topic V

WILDLIFE IN THE AIR

GOALS: After this lesson the children should:

Understand the general characteristics of birds.

Possess guidelines and information about how to attract and study the birds in their area.

ACTIVITY 1: Examining Birds:

Using Worksheet C-13,(duplicate enough copies to give each child one) have the children observe a bird and fill the information in on the worksheet. This will help the children learn how to observe birds. At this point, try to help the student discover similarities and differences. Do not be concerned about the identification of particular birds. Some students will naturally be more interested in this activity than others, so you may want to have extra worksheets for them.

ACTIVITY 2: Identifying Birds

Worksheet C-4 offers some ideas for bird feeders that are very simple to make. Place the feeders at different points around the school and encourage the children to observe them on a regular basis. The frequency of visits to a particular feeder will probably depend on the amount of cover near the feeder. If cover is lacking, make sure to point out to the children that birds need not only food but cover.

Using a good field guide to birds, have the children try to identify the birds that they observed. The observation of birds can and should be an activity that goes on all year. The establishment of feeding stations and bird attraction devices will make the activity very interesting and will give the children the opportunity to observe birds at close range.

ACTIVITY 3: Making Comparative Studies

Place several bird feeders with the same kind and amounts of food at different distances from shrubs or trees, and observe the results.

Have the children develop a list of the birds observed in their area and notice how the kinds of birds observed change with the season and time of day.

EVALUATION:

Given the opportunity to describe a bird that he has observed, the student will mention the following: size, shape of tail, color of breast, head, back, wings and throat, and shape of bill.

Given the opportunity to combine the observation of birds with a field guide selected by the teacher, the student will be able to identify several species of birds that visit feeding stations around the school.

Section C - Wildlife

Topic VI

FOOD CHAINS

GOALS: After this lesson the children should:

Understand food chains within the wildlife kingdom.

Understand that all living things are a part of the food chain, and are therefore interdependent.

ACTIVITY 1: Classifying Animals by the Food They Eat.

All food is produced by green plants. Review *Forests and Grasslands*, Topic VI. These plants are called *producers*.

Animals are consumers; they eat the food that is produced.

Animals that eat plants are called *herbivores* and are primary *consumers*.

Animals that eat meat are called *carnivores* and are secondary *consumers*.

Animals that eat both plants and meat are called *omnivores*.

TEACHER'S NOTE: The term meat-eaters and plant-eaters may be used without affecting the lesson. If the children are ready for the words above, use them.

Have the children make lists of animals that are:

1. Herbivores
2. Carnivores
3. Omnivores

Which list should include man?

ACTIVITY 2: Understanding Why Animals Eat What They Eat

Using the lists above, have the children try to find out reasons why certain animals eat certain things. Have them answer the following questions:

If they have teeth, what kind of teeth do they have?

How big are their bodies?

What kind of feet do they have? (This question is particularly important in the case of birds.)

A wolf is a carnivore. He must eat meat (remember "Little Red Riding Hood?"). Lions, tigers, and leopards are also carnivores.

What do all four of the animals above have in common?

ACTIVITY 3: Discussing Predator-Prey Relationships

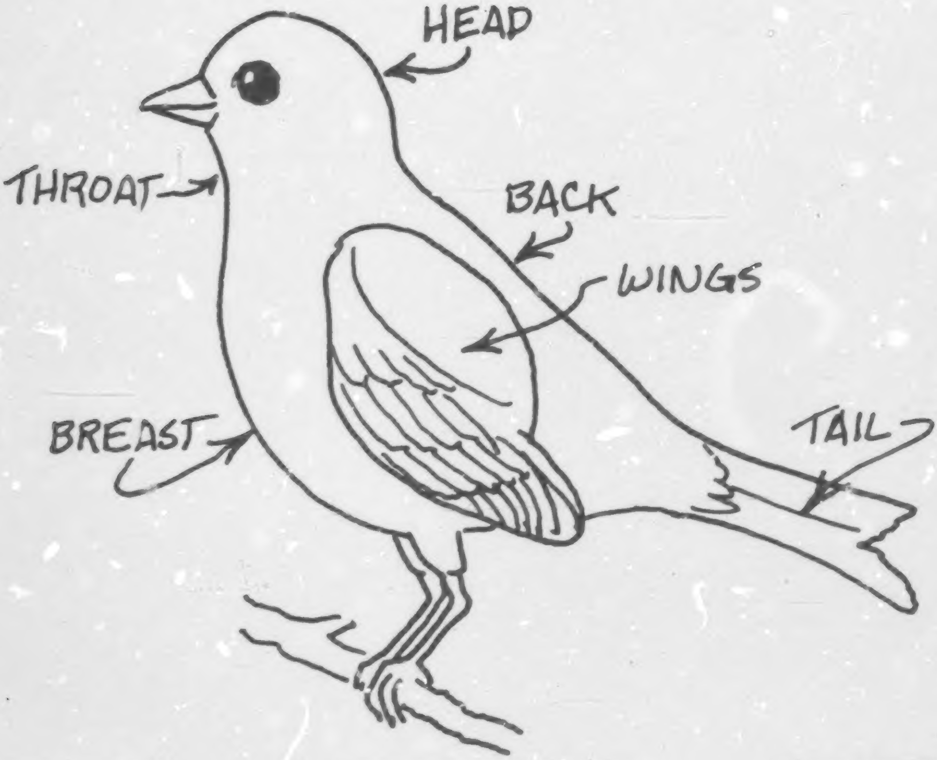
An animal that is eaten is called the *prey*.

Predator-prey relationships are very important in nature.

The fur companies in the North keep records of the number of fox (predator) and rabbit (prey) furst that are sold to them each year. The graph on page 77 is a representation of these findings: Be able to define the word

WORKSHEET C-3

Use as an aid in identifying birds.


HEAD
THROAT
BACK
WINGS
BREAST
TAIL

SIZE

CROW ☐
ROBIN ☐
SPARROW ☐

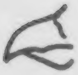
TAIL SHAPE

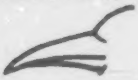
FORKED ☐
NOTCHED ☐
SQUARE ☐
ROUNDED ☐

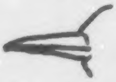
COLOR

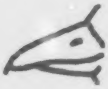
☐

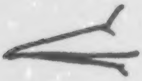
SHAPE OF BILL

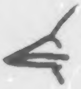
 ☐

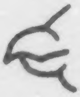
 ☐

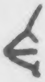
 ☐

 ☐

 ☐

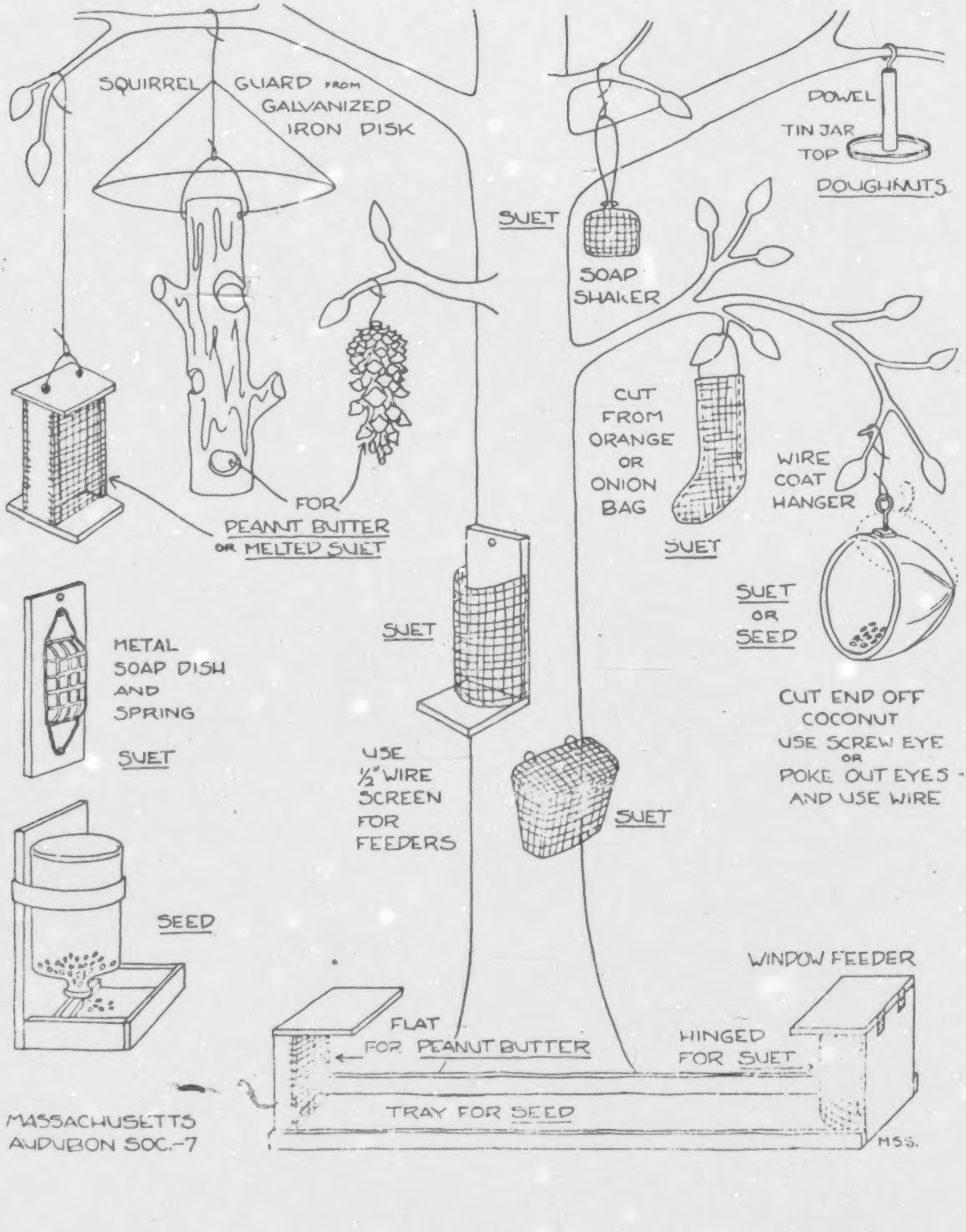
 ☐

 ☐

 ☐

WORKSHEET C-4

Simple birdfeeders you can make.


SQUIRREL GUARD FROM GALVANIZED IRON DISK
SUET
SOAP SHAKER
DOWEL
TIN JAR TOP
DOUGHNUTS
CUT FROM ORANGE OR ONION BAG
WIRE COAT HANGER
FOR PEANUT BUTTER OR MELTED SUET
SUET
SUET
SUET OR SEED
METAL SOAP DISH AND SPRING
SUET
CUT END OFF COCONUT
USE SCREW EYE OR POKE OUT EYES - AND USE WIRE
USE ½" WIRE SCREEN FOR FEEDERS
SUET
SEED
WINDOW FEEDER
FLAT FOR PEANUT BUTTER
HINGED FOR SUET
TRAY FOR SEED
MASSACHUSETTS AUDUBON SOC.-7
M.S.S.

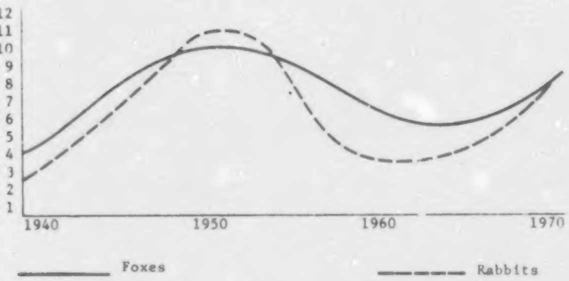


Figure C-9

Ask the children what this means to them. Why don't the foxes keep increasing as the rabbits increase? Why do the rabbits and foxes both fluctuate in their numbers? What kind of information would we need to tell the whole story?

TEACHER'S NOTE: As foxes eat more rabbits, there is less food for the foxes–so there are fewer foxes. Fewer foxes mean more rabbits. Rabbits will only have a certain amount of vegetation upon which to live, so when their population reaches a certain peak, the foxes start to have more food and their population increases, and the cycle begins again.

Have the children try to discover other predator-prey relationships among the animals in their state.

ACTIVITY 4: Discussing Decomposers

There are animals that eat dead animals and return them to the soil. These are called *decomposers.* Most decomposers are very small in size and large in number. They are not equipped to kill their own food so they must eat animals that are already dead.

EVALUATION:

Given the opportunity to answer the questions below, children will demonstrate an awareness of the way food material cycles through the environment and will be able to explain the role that producers, consumers, and decomposers play in that cycle.

What would happen to our soil if organic material were not returned to it?

What would happen to our plants if the soil did not provide the materials that they need?

What would happen to our animals if the plants did not grow?

Using drawings, photographs, appropriate labels and arrows, have the students depict food cycles in the environment on a bulletin board.

Section C - Wildlife

Topic VII

WILDLIFE MANAGEMENT

GOALS: After this lesson the children should:

Be able to define the word *habitat*.

Understand the relationship between habitat type and condition, and population.

Understand the necessity of management of wildlife population size.

ACTIVITY 1: Defining a Habitat.

Habitat may be described as the surroundings that provide an animal with the proper amounts of food, cover, and water in a condition of proper temperature range.

Have the children explore the areas around their school and try to discover animal habitats.

TEACHER'S NOTE: This can be done by the observation of any one animal. Squirrels are a good example because they are abundant in most areas of the country. The grey squirrel requires woodland and prefers hardwoods. Have the children observe a grey squirrel for a period of time and answer the following questions:

Where did you first notice the squirrel? (Describe the surroundings.)

What was the squirrel eating?

Where did the squirrel run when he was frightened?

TEACHER'S NOTE: The grey squirrel is used here as an example. The same questions can be asked and answered about any animal that the children observe in their neighborhood.

If any one limiting factor within a habitat is not within an animal's range of needs, the number of animals will decrease.

Example:

Squirrels like to eat acorns. In the middle of a meadow there is a very large oak tree occupied by 15 squirrels. The squirrels found plenty to eat and had good cover because the tree was very large. But for several years there was no rain and the tree did not produce enough acorns to feed the 15 squirrels.

Ask the following questions regarding the above statement:

What would happen to the number of squirrels in the tree?

If some squirrels did not leave and find new sources of food and the number remained the same, what would happen to all 15 of them?

If the tree were in your meadow and you wanted to help the squirrels during this period of time, what would you do?

ACTIVITY 2: A Simulated Wildlife Management Problem

The average whitetail deer needs about 10 pounds of browse per day in the winter time. (Browse is usually considered twigs that are 1/8 inch or less in diameter, and 10 pounds is about 1 bushel basket full.)

The State Game Commission is able to determine the amount of browse that is available for deer to eat in the winter woods.

Suppose, for example, the Game Commission determined that a particular county had enough browse to feed 5,000 deer. They also know that the approximate number of deer in the county is 8,500 deer.

This means that if 3,500 deer are not harvested, not only will they die of starvation, but the other 5,000 deer will not get enough to eat and all of them will be affected.

Under natural conditions, the deer population would have been controlled by the predator-prey relationship that was discussed in Topic VI, "Food Chains." Man, however, has done away with natural predators such as mountain lions and wolves because they not only ate deer but also cattle and sheep.

The predator then must be replaced and the hunter serves this function. By keeping careful records of the hunters/huntersuccess ratio, the Game Commission can issue the proper number of licenses and the proper number of deer will be harvested each fall.

Have the children figure the following problem.

If 50 percent of the hunters shoot a deer each year and you want to harvest 2,000 deer, how many hunting licenses should be issued?

TEACHER'S NOTE: While the figures in the above step are fictitious, the facts that support them are accurate and are a very good example of one of the ways that man must manage his wildlife resources.

EVALUATION:

Given the opportunity to define habitat, children will demonstrate a knowledge of the fact that habitat is the place where animal lives and that this place must provide the animal with t conditions necessary for life.

Given the opportunity to answer the question: "What w determine the number of animals that can live in a giv habitat?" children will demonstrate an awareness of the relatio ship of the quantity of food, water, and cover to the number animals in an area.

If asked why we sometimes need to harvest animals as a part o management program, children will demonstrate an awareness the fact that man must sometimes take the place of the predat in order to keep animal populations in the proper relationship their environment.

Section C - Wildlife

Topic VI

WILDLIFE AND MAN

GOALS: After this lesson the children should:

Appreciate the fact that wildlife provides man with many of the things he needs.

Understand that wildlife is a very important recreational asset.

ACTIVITY 1: Understanding the Importance of Wildlife to Primitive Man.

Have the children study Indian tribes and answer the following questions about them. (Tribes in this case do not mean just American Indians, but also Eskimo, African, South American, and Australian tribes.)

What kind of animals live near the tribes?

What do the animals provide the tribes with?

Do the Indians kill more animals than they need?

ACTIVITY 2: Understanding the importance of Wildlife to Modern Man.

Modern man depends on wildlife to meet not physical, but psychological and educational needs.

Modern technology has enabled man to change things in natu to meet his needs. This has caused man to forget that ev though he changes natural resources he still depends upon the and must use them well.

Through the observation of wild creatures that use the natu resources directly, we are reminded of the dependence of livi things on each other and on the natural resources that surrou them.

Children should be encouraged to observe and study wildli Even if the wildlife is a pigeon or a mouse in the middle of t city, there is a great deal to learn from their behavior.

EVALUATION:

When asked to discuss the way some tribes used wildli children will demonstrate an awareness of the fact that wildl was used to meet their physical needs.

If given the opportunity to observe wildlife children will, to t satisfaction of their teacher, discover that animals are depende upon natural resources.

Section C - Wildlife

Topic I

PEOPLE WHO WORK WITH WILDLIFE

GOALS: After this lesson the children should:

Be aware of the occupations that exist in the area of fish and wildlife management.

Understand the nature of the work tasks performed by fish and wildlife workers.

ACTIVITY 1: Discussing Occupations in Fish and Wildlife

The fish in our streams and lakes, as well as the deer, rabbit, quail, and turkey in the forests of our country, are examples of the wildlife natural resources available to us. Although early settlers depended heavily upon fish and game animals for food and fur, people today fish and hunt mostly for recreation.

Some of our streams and lakes are now fished so heavily that the natural growth in fish population cannot keep up with the number of fish removed. Fish hatcheries grow fish from eggs to fingerling size under controlled conditions. These fish are th released in lakes and streams at a size big enough to continue grow for months and years. A *Fish Hatchery Worker* keeps t hatchery tanks clean, collects the fish eggs and cares for t small fish.

An individual who studies the things that affect the number a kinds of fish in a particular stream or lake is called a *f biologist*. By finding out what water temperatures, kinds food, and water pollution do to fish, this person can recomme ways of improving conditions that will result in better fishing.

A *fish technician* helps the fish biologist by collecting fish determine what they have eaten, where they move in a lake stream, and which kinds grow best in a particular body of wat

Although deer and rabbits are able to maintain their populatio well, the young of certain wild game birds, such as quail, turk

duck, and pheasant do not survive well. A *game propagator* is a person who works at a game farm and hatches eggs of these birds. The game propagator cares for the small birds until they are big enough to get along on their own, when they are released in forests and open fields.
areas where they are likely to develop higher populations without any further help. A *wildlife biologist* studies wildlife to determine the conditions under which they grow best, and then tries to provide those conditions. This individual often talks to groups of people who are interested in preserving the wildlife in our forests and natural areas.

A *wildlife technician* helps the wildlife biologist by capturing animals for study, maintaining study enclosures, and keeping records.

A *game warden,* or *game protector,* patrols streams, lakes, forests, and wildlife preserve areas to make sure that fishermen and hunters are not taking animals by illegal means or are not taking them from areas set aside as game preserves. This individual often helps release fish in streams or animals and birds in hunting areas or preserves. The game protector is especially concerned to protect species of animals that are in danger of extinction.

ACTIVITY 2: Developing a Bulletin Board

Have the children develop a bulletin board of pictures of people working with fish and wildlife. Pictures may be found in sports of outdoor publications. Group the pictures so as to illustrate clusters of similar careers as well as the many different jobs represented in this natural resources area. Have the students study and react to the display during a class discussion.

ACTIVITY 3: Interviewing Resource Persons

Contact the local game warden and arrange for him to meet your class at school or the class to visit his office to become better acquainted with this work.

EVALUATION:

In an oral exercise, the student can identify at least four types of workers who manage and protect the wildlife and fish.

The student can state how different wildlife and fish workers contribute to his well-being and the welfare of the community.

Section C - Water

Topic I

WHAT IS WATER?

GOALS: After this lesson the children should:

Understand the chemical structure of water.

Be aware of the nature of chemical combinations and how two atoms can combine and form a molecule.

ACTIVITY 1: Describing a Molecule of Water

An *atom* is the smallest particle of an element that can be identified as that element.

Atoms consist of a nucleus that contains protons and neutrons, and they also have electrons in orbit around them.

Protons and electrons have electrical charges while neutrons do not. The path that the electrons take around the nucleus of an atom is called an *orbit*. In some atoms with many electrons, the electrons may be distributed in several orbits. Each orbit can hold only a certain number of electrons. The first orbit in any atom, for example, will hold only 2 electrons. The next orbit will hold 8. A hydrogen atom, however, has only one electron in its first orbit because it has only one proton and one neutron in its nucleus.

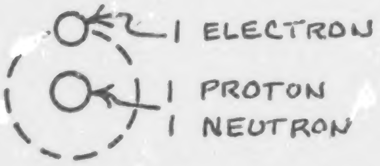


Figure C-10

An atom that is in this condition will have an electrical attraction for another atom that will share an electron and thus complete the outer orbit with 2 electrons.

An oxygen atom has an outer orbit with 6 electrons and therefore would need two more because the outer orbit of an oxygen atom will hold 8.

If we have one oxygen atom that needs two electrons to complete its outer orbit and two hydrogen atoms that each need one electron to complete their outer orbits, they will combine and form water. This is why we have the formula H_2O. There are 2 hydrogen atoms for each oxygen atom.

A diagram of this molecule of water would look like this.

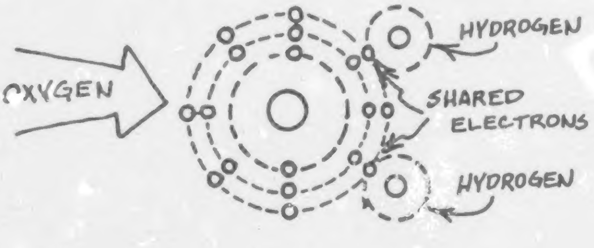


Figure C-11

The hydrogen will share one electron from the oxygen atom, and oxygen will share one electron from the hydrogen atom, and the combination will be balanced..

EVALUATION:

Given the opportunity to explain the process where the atoms of hydrogen and oxygen combine to form water, children will demonstrate to the teacher's satisfaction an understanding of the basic electrical attraction of one atom for another.

Section C - Water

Topic II

FORMS OF WATER

GOALS: After this lesson children should:

Understand the physical properties of water.

Understand that a change in the physical form of water is the result of a change in temperature.

ACTIVITY 1: Watching Water Change

Place an ice cube in a saucer and put it in direct sunlight.

Have the children observe the saucer from time to time until the water is gone and then ask the following questions:

What words could you use to describe the form of the water as it changed?

The children will observe the solid and liquid state, and may guess that when the water evaporated it became a gas. You should point out to them that they did not really observe the gas or vapor.

How could we prove that the water actually evaporated and went into the air?

What caused the changes to take place?

ACTIVITY 2: Defining Words About Water Change

Freezing: Water changes from a liquid or vapor to a solid at 32° Farenheit or 0° Centigrade.

Thawing: Water changes from a solid to a liquid at approximately 33° Farenheit or 1° Centigrade.

Evaporation: The change of water from a liquid into a gas (water vapor), usually by dissolving into air. (We discuss this further when we talk about relative humidity in Topic III, The Water Cycle.)

Condensation: When air with a very high water vapor content is suddenly cooled, droplets of water form as a condensate. (This can be demonstrated by breathing on a mirror or window pane.)

Precipitation: The way that water comes back to earth in the form of rain, sleet, snow, or hail as a result of water condensation in the atmosphere.

ACTIVITY 3: Studying the Effect of Temperature on Water

All changes in the form of water depend upon temperature, and water reacts in unique ways as the temperature changes.

For example:

Cold

As the temperature of water gets very close to the freezing point, water starts to expand rather than contract. This can be demonstrated by putting a small bottle filled with water inside a plastic container and letting the water freeze. This will break the glass bottle. (The plastic container will keep the broken glass in one place. Do not forget to put the cap tightly on the bottle and make sure it is completely filled with water.)

After children have observed the above demonstration, ask them the following question:

In what way does this demonstration explain the weathering of rocks?

TEACHER'S NOTE: It is this characteristic of water that causes rocks to be broken apart by alternate freezing and thawing.

Heat

As water reaches approximately 212° F (at sea level), it boils. As water boils, it goes into a gaseous or vapor stage (steam).

The warmer water gets, the more rapidly it evaporates; and as it evaporates it absorbs heat from whatever surface it touches. This is called the *Heat of Evaporation*, and is very important to our weather patterns as we will see in the following topics on water.

EVALUATION:

When aked to identify and describe the physical forms of water, the children will describe them as solid (ice), liquid, and gas or vapor.

When asked to describe the following list of terms, children will give descriptions that are satisfactory in the judgment of the teacher:

freezing, thawing, evaporation, precipitation, condensation

When asked to discuss the relationship of water to temperature change, children will, by their comments, demonstrate a knowledge of the effect of a rise or fall in temperature on water.

Section C - Water

Topic III

THE WATER CYCLE

GOALS: After this lesson children should:

Understand that water is a renewable natural resource.

Understand the relationship of water's physical properties to weather phenomena.

TEACHER'S NOTE: The organization of this topic will be to first explain the general water cycle and then to explain and demonstrate the relationship of the physical properties of water to each stage of the cycle. Make an overhead transparency from Master C-11 for use when explaining the water cycle. The aim for now will be simply to have the children understand what happens to the water, not how it happens.

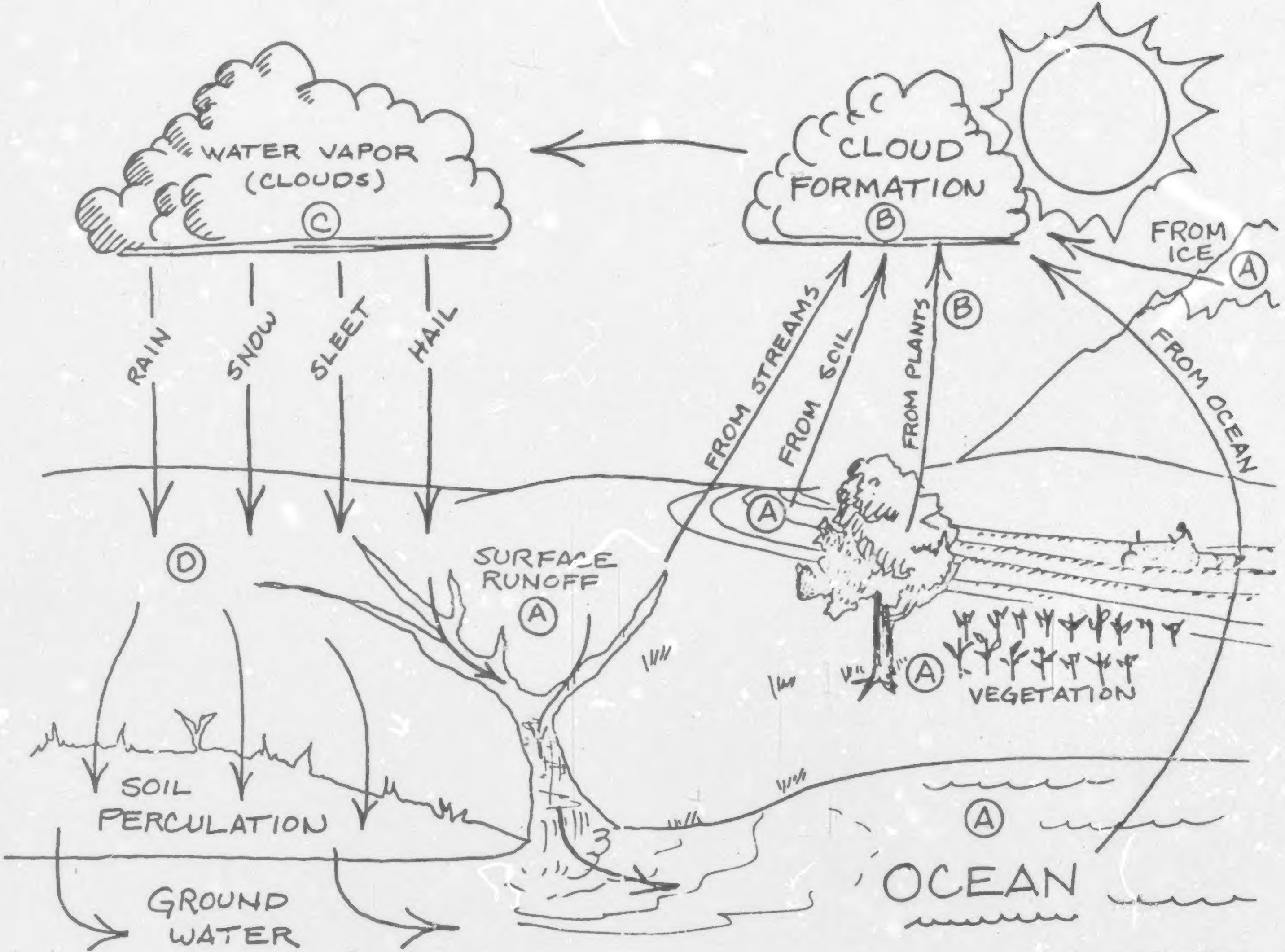
ACTIVITY 1: Learning About Water Form Vegetation

Plants give off water through a process called *transpiration*. Transpiration is the evaporation of water directly from plant leaf surfaces.

The *dew point* is reached whenever moist air comes into contact with a surface that is cool enough to cause the water to condense on that cool surface. (That surface could be a house roof, an automobile, or a leaf blade.)

ACTIVITY 2: Learning About Water from Ice

If the *vapor pressure* (amount of water vapor in the air) above an ice or snow field is less than that on the surface, water will go


WATER VAPOR
(CLOUDS)
Ⓒ
CLOUD
FORMATION
Ⓑ
FROM ICE
Ⓐ
FROM OCEAN
FROM STREAMS
FROM SOIL
FROM PLANTS
Ⓑ
RAIN
SNOW
SLEET
HAIL
Ⓓ
SURFACE
RUNOFF
Ⓐ
Ⓐ
Ⓐ
VEGETATION
SOIL
PERCULATION
GROUND
WATER
Ⓐ
OCEAN

directly into the atmosphere as vapor through a process called *sublimation*.

TEACHER'S NOTE: The process of sublimation also works in reverse. If the vapor pressure above the ice or snow is greater than that on the surface and the dew point is below the freezing temperature, water condenses on the snow or ice.

ACTIVITY 3: Learning About Water from Streams and Soil

Water from streams, soil, oceans, and rivers or any other water or land body, ***evaporates*** and goes into the vapor state in the atmosphere.

TEACHER'S NOTE: Remember that all of the methods mentioned (transpiration and sublimation) are forms of evaporation and depend upon the same properties of water. We will now discuss the relationship of evaporation to weather.

ACTIVITY 4: Learning About Evaporation and Relative Humidity

Relative humidity is the term that describes the amount of water that a given quantity of air contains at a particular temperature compared with the quantity it could hold if the air were fully saturated at the same temperature. It is always stated in percent. A 50 percent relative humidity means that the air contains one-half the amount of water it would hold if fully saturated.

If you have weather instruments, you will either use a wet-dry bulb thermometer or a sling psychrometer to measure relative humidity. If you do not have instruments for the measurement of relative humidity, you may make a sling psychrometer by using the following exercise.

Have small groups of children measure the relative humidity and ask them the following questions:

Why does the temperature on the wet bulb side change? (If it did not change, you have a relative humidity of 100 percent. Simply re-phrase the question to why didn't it change?

What happens to the water as we sling the psychrometer around or as air flows over the wet bulb?

EXERCISE

Make a sling psychrometer.

Procedure:

a. Purchase two inexpensive metal backed thermometers.
b. Place the thermometers back to back and drill holes at points A, B, and C as shown below.
c. Put small bolts and nuts through holes B and C to hold the thermometers together.
d. Put a small key ring through the hole in point A.
e. Attach a length of cord or light chain through the key ring (about 12 inches in length).
f. Attach the other end of the cord or chain to a handle so that the psychrometer will swing freely.
g. Using cotton, make a small sock that will fit snugly over one of the thermometer bulbs. Just wrap one layer of the cotton around the bulb and tie it at the top and bottom as shown below.
h. Soak the sock in water until it is saturated.
i. Sling the psychrometer around for 1 minute after reading and recording both sides.
j. Read and record the temperature from both sides again and refer to the chart below for the relative humidity.

Example: A dry bulb reading of 73°F and a wet bulb reading of 65°F would mean a relative humidity of 65%.

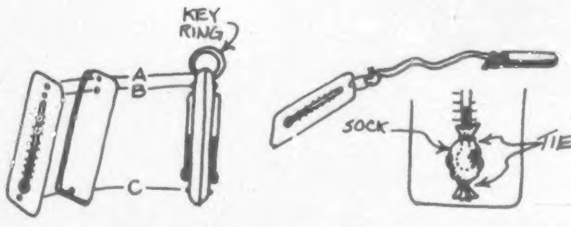


Figure 1. Relative Humidity Percent Derived from Wet Bulb and Dry Bulb Temperatures

Readings of dry bulb thermometer	Difference in degrees fahrenheit between wet and dry bulb thermometers															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
60	100%	94%	89%	84%	78%	73%	68%	63%	58%	53%	49%	46%	40%	35%	31%	27%
61	100	94	89	84	79	74	68	64	59	54	50	45	40	36	32	28
62	100	94	89	84	79	74	69	64	60	55	50	46	41	37	33	29
63	100	95	90	84	79	74	70	65	60	56	51	47	42	38	34	30
64	100	95	90	85	79	75	70	66	61	56	52	48	43	39	35	31
65	100	95	90	85	80	75	70	66	62	57	53	48	44	40	36	32
66	100	95	90	85	80	76	71	66	62	58	53	49	45	41	37	33
67	100	95	90	85	80	76	71	67	62	58	54	50	46	42	38	34
68	100	95	90	85	81	76	72	67	63	59	55	51	47	43	39	35
69	100	95	90	86	81	77	72	68	64	59	55	51	47	44	40	36
70	100	95	90	86	81	77	72	68	64	60	56	52	48	44	40	37
71	100	95	90	86	82	77	73	69	64	60	56	53	49	45	41	38
72	100	95	91	86	82	78	73	69	65	61	57	53	49	46	42	39
73	100	95	91	86	82	78	73	69	65	61	58	54	50	46	43	40
74	100	95	91	86	82	78	74	70	66	62	58	54	51	47	44	40
75	100	96	91	87	82	78	74	70	66	63	59	55	51	48	44	41
76	100	96	91	87	83	78	74	70	67	63	59	55	52	48	45	42
77	100	96	91	87	83	79	75	71	67	63	60	56	52	49	46	42
78	100	96	91	87	83	79	75	71	67	64	60	57	53	50	46	43
79	100	96	91	87	83	79	75	71	68	64	60	57	54	50	47	44
80	100	96	91	87	83	79	76	72	68	64	61	57	54	51	47	44

TEACHER'S NOTE: As the water evaporates from the sock, heat i required. This heat of evaporation comes from the thermomete bulb and is reflected by its reading. This same principle is ver important to the human body Perspiration forms on our body evaporates, and takes heat away. This helps us to maintain ou temperature at 98.6°

What would happen to the water in the sock if we sling i around inside of a cloud where the humidity if 100 percent?

No water would evaporate because the air will not accept an more. No evaporation, no heat taken away, no temperatur change.

ACTIVITY 5 Studying the Formation of Clouds

We have discussed the various ways that water gets from th various earth sources into the atmosphere, and how moist an dry air mix together.

The next step in the water cycle is the movement of moist air.

Air that is heated by the sun's rays or any other method wi expand and rise. The same volume of warm air is lighter tha cool air, so it rises. Rising air finally reaches a point high in th atmosphere where it is cooled by surrounding cool air and th water dissolved in it starts to condense on tiny dust particles tha are always present in the air. The condensation of water on th dust particles makes very fine water droplets which we can see a cloud.

TEACHER'S NOTE: This same phenomenon can be observed clo to the ground as *fog*. On a relatively calm, warm day, it is sometim possible to watch clouds form and enlarge overhead as masses heated air rise into a cool air layer

Fog is really a very low cloud and is formed when the amount moisture evaporated goes into air that does not move upwar and is at the proper temperature to cause condensation.

Hot moist breath exhaled on a cold day will also produce immediately observable cloud, as will water vapor (stear coming from a tea pot.

In the cases of fog, visible breath, and steam a mass of air at 1 percent R.H. is suddenly cooled, and the air can no longer ho all of the water vapor that it contains (it has passed the "de point"), so the water vapor condenses to form droplets that a visible.

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TEACHER'S NOTE: Discuss the movement of air and air masses in Topic IV, "Atmospheric Cycles and Weather" in the section on Air. For now, our concern is to have children understand that as air rises it cools and water condenses.

ACTIVITY 6: Learning About Precipitation

Water has now reached the point through evaporation upward movement, and condensation where all it really has to do is fall out of the sky and it is back where it started from.

The condensed water that we observe in clouds is exactly the same thing that we observe when precipitation occurs except for one major difference. Water in clouds is too light to fall from the cloud.

This "light water" is usually held up in the cloud because of upward air currents. In order for it to rain, the droplets of water in the cloud must "grow" large enough to become so heavy that these upward air currents can no longer hold them against the force of gravity.

Ask the children this question and see if they can see the relationship between a drop of condensed water and the water vapor that surrounds the drop.

How does a water droplet grow?

Prepare an overhead transparency from Master C-12. This will be helpful in explaining how water droplets grow.

TEACHER'S NOTE: In order for precipitation to be understood, recall some of the things learned about water. For example: if the vapor pressure surrounding a water droplet is less than 100 percent, the water droplet will evaporate. If the temperature is above the dew point, water will not condense. Also, warm air is capable of holding more water vapor than cold air. Keep these things in mind when explaining precipitation and help children to recall the properties of water that cause rain, snow, sleet, or hail to occur. A drop of water falling from a cloud travels very fast and can hit the ground with great force.

(Review Topic VI, Step I, "Soil Moves.") It is important for the children to be reminded of the role that plant leaf surfaces play in intercepting a water droplet and slowing it down before it reaches the soil.

EVALUATION:

Using Master C-11 as a criterion, children will be able to explain the pathway that a drop of water takes from any point on the chart through the water cycle.

When shown Master C-11 and asked to explain what is happening to water at points "A," children will identify evaporation and transpiration. At point "B" they will identify upward movement, cooling, and condensation. At point "C" they will identify precipitation, and at point "D" they will explain that leaf surfaces break the fall of water.

Given the opportunity to define the terms evaporation, transpiration, sublimation, dew point, relative humidity, and vapor pressure, children will demonstrate their understanding of these terms to the satisfaction of their teacher.

Section C - Water   Topic IV

WATER AND CLIMATE

GOALS: After this lesson the children should:

Understand that water changes temperature very slowly as compared to land and air.

Understand the relationship of the cooling or heating of water to the movement of air.

ACTIVITY 1: Water Temperature

Water is very slow to heat up or cool down. This is because water has a very high *Specific Heat.* Specific heat is defined as the amount of heat required to raise a particular amount of substance a particular number of degrees.

One *calorie* heat is the amount of heat needed to raise 1 gram of water 1 degree centigrade. *The specific heat of water is 1 calorie.*

Compare the specific heat of water – 1 calorie – to the specific heat of sand – .188 calories – and you can see that the amount of time it would take for the sun to warm the two surfaces would be quite different.

The sand would heat up much more rapidly than the water during the day and would cool much more rapidly at night. This same thing is true of any land surface, and is very important to the climatic situation in a given area. Plants contain a lot of water; this is why forests and grasslands change temperature much less rapidly and violently than deserts.

ACTIVITY 2: Learning About Land and Sea Breezes

Make an overhead transparency from Master C-13 to show the effect of the different ways that land and water take up and retain heat.

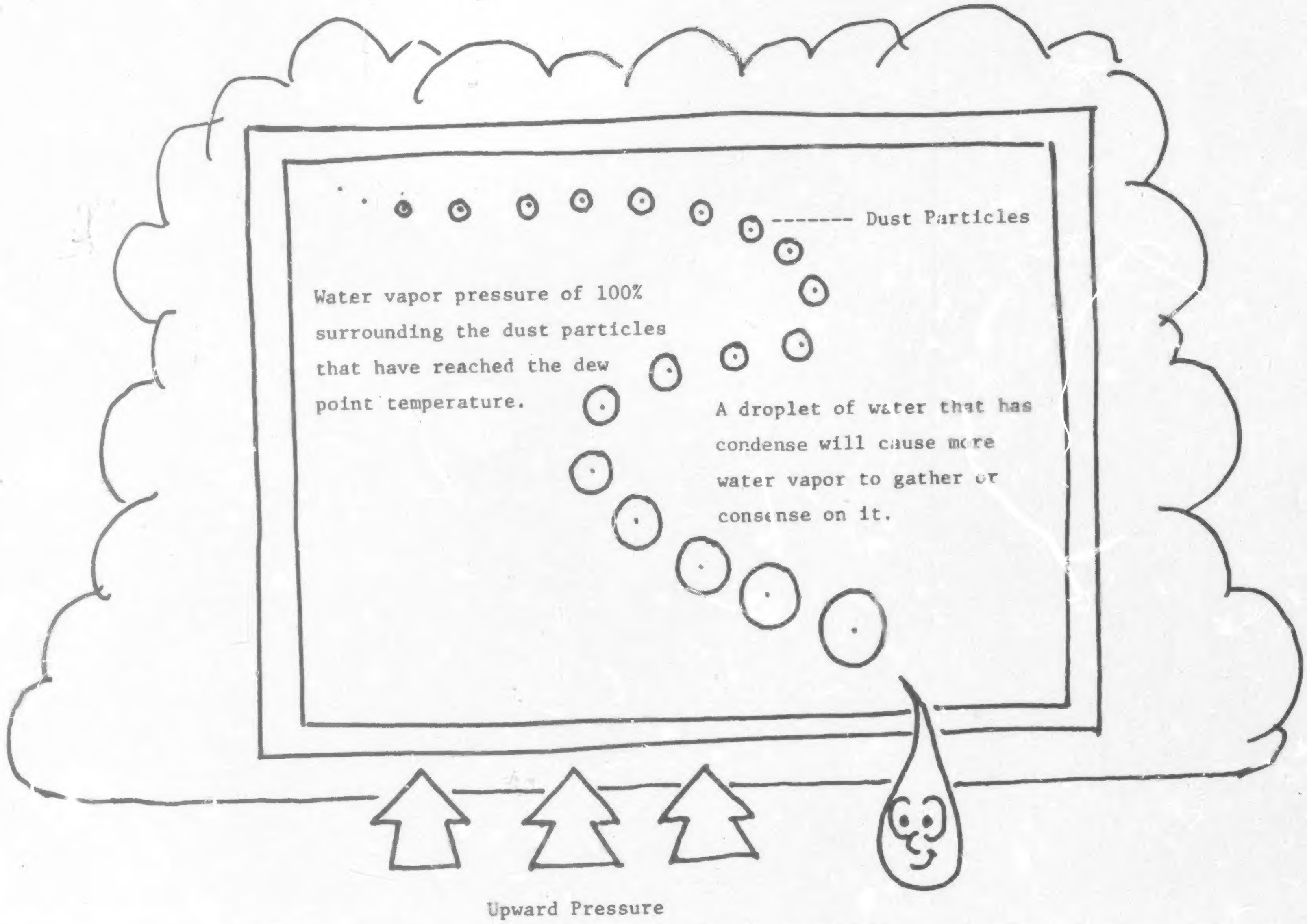
During the day the land is heated more than the water. The air over the land warms rapidly and rises. The cooler air over the water, being more dense, moves in to replace the heated air over the land. The lower air masses then move from the water toward the land. At night the land cools more quickly than the air, the reverse takes place, and the wind direction changes.

TEACHER'S NOTE: This land/sea breeze phenomenon is mentioned here because it is particularly relevant to water. The relationship of this to overall weather conditions will be further discussed in the section on Air, Topic IV, "Atmospheric Cycles and Weather." It should be pointed out that this occurs only in local situations, and is mentioned here as an example.

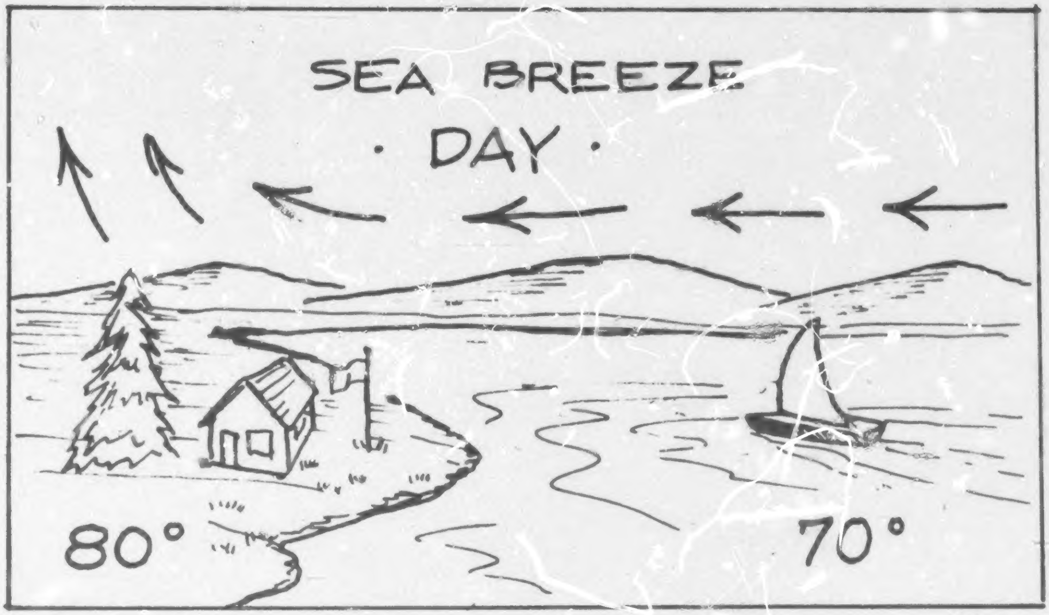
EVALUATION:

Given the opportunity to discuss land and sea breezes, children will demonstrate a knowledge and understanding of the relationship of the specific heat of water to the movement of air as described in Activities 1 and 2.

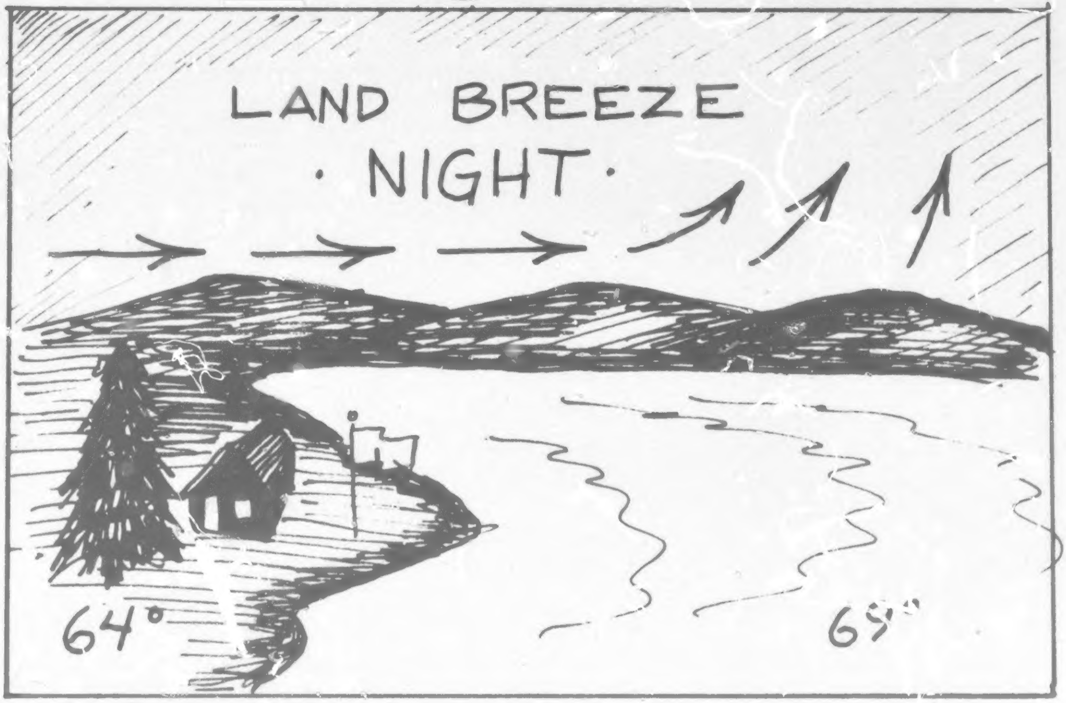
MASTER C-12


Dust Particles
Water vapor pressure of 100% surrounding the dust particles that have reached the dew point temperature.
A droplet of water that has condense will cause more water vapor to gather or consense on it.
Upward Pressure

A


SEA BREEZE
· DAY ·
80°
70°

B


LAND BREEZE
· NIGHT ·
64°
65°

Section C - Water Topic V

WATER AND ANIMALS

GOALS: After this lesson children should:

Understand the importance of water to animals.

ACTIVITY 1: Review

Review "The Effect of Man's Use of Natural Resources," Section B, Topic IV.

ACTIVITY 2: Discussing the Importance of Water to Animal Life

The human body is approximately 71 percent water. A jellyfish is over 99 percent water! An embryo is bathed in a watery solution until birth; animals depend on water for every organic function.

A solution of water is necessary for breathing, excretion, glandular activity, digestion, and heat dissipation.

Water Loss

Water is lost from animal tissue through excretion and evaporation.

Ask the children to figure out why they perspire. How does perspiration relate to the things we learned about water in Topic III?

Water Replacement

We must maintain a constant amount of water in our bodies.

The average person in the temperate zone must replace 5-6 pints of water per day that is lost through perspiration and excretion.

Water and Survival

History is filled with stories of people who have not been able to survive because they could not find a source of fresh water.

It has been estimated that an animal could lose nearly all of its fat and 50 percent of its protein and still survive, but if the body were to lose about 10 percent of its water, death would occur.

Drs. Frank and John Craighead, writing in *How to Survive on Land and Sea,* report that "without water, a man in good health will become delirious in about four days; death will occur in from eight to twelve days. If you have water and are in good health, you may live weeks without food. Survivors have been known to live for 10 days or more on as little as two or three ounces of water per day without causing any apparent bodily damage."

ACTIVITY 3: Constructing a Solar Still

An activity that you might use to help children to appreciate water and to simulate a method of obtaining water in a survival situation is the construction of a solar still shown on the Exercise below. This activity may also be used demonstrate the water-holding capacity of soil.

EVALUATION:

Given the opportunity to give reasons for our needing water, children will indicate a knowledge of the fact that none of our organic functions would work without water.

Given the opportunity to describe the relationship of perspiration to body temperature regulation, children will demonstrate knowledge of the way water reacts to changes in temperature and relative humidity..

EXERCISE

A SOLAR STILL

You will need: 1 piece 3' x 3' plastic
1 tin can or jar

Procedure:

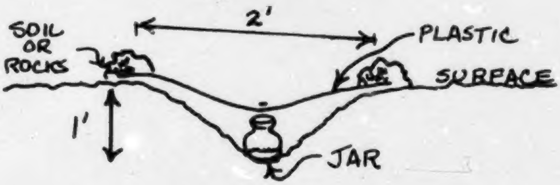
a. Dig hole 2 feet in diameter sloping to a depth of 1 foot.

b. Save soil from hole.

c. Layer plastic over hole after placing can or jar in low part of hole to catch water.

d. Seal edges with soil that they will also serve to hold plastic.

e. Place stone in middle of plastic and allow plastic to slip until stone is right above but not touching jar.



What will happen:

The sun will heat the air between the soil and the plastic causing water in the soil to evaporate. This evaporated water will condense on the plastic, run downhill because of the stone, and drip into the jar.

Section C - Water Topic VI

PEOPLE WHO WORK WITH WATER

GOALS: After this lesson children should:

List four or more occupations which deal with the natural resource water.

Understand how different workers in water contribute to the childrens' well-being and the welfare of the community.

ACTIVITY 1: Discussing Occupations Relating to Water

Water is one of our most important natural resources. Crops can be grown only in good soil supplied with enough water. Cities can grow only if there is enough pure water for drinking, cooking, and washing. Paper mills, steel mills, food processing companies, and many other industries can be located only where there is an abundance of good water. The waste water from a community must be returned to the streams and rivers in clean enough condition so that the next community downstream can reuse it. In desert areas the water stored behind dams can be used for irrigating crops that could not otherwise be grown. The water falling from these dams is often used to turn turbines that produce electrical power for pumping the irrigation water to the crop fields.

Salt water fish are now eaten almost everywhere in the United States. Some people study the plant and animal life of the oceans so more fish can be caught.

A man who checks up on the quality of water for drinking, cooking, and washing is called a *water resource investigator*. If he finds that water used for this purpose has become polluted, he must find the source of pollution and get it cleaned up so people will not get sick from drinking unclean water.

A *water well inspector* does the same thing, except that instead of testing lakes, streams, and rivers he tests water from wells.

Drinking water in most communities goes through a treatment plant before it is piped to homes, schools, businesses, and factories.

Any silt or other solid particles in it are filtered out and it is chlorinated to kill disease germs that might be present. A *water treatment technician* operates the pumps, filter leads, and chlorinating machines that are used in doing this.

The water that has been used for food preparation, washing dishes and people, or disposing of waste, is piped to a wastewater treatment plant where it is treated before being returned to a stream, river, or lake. The man who controls the filter beds, processing tanks, and machines for adding chemicals is called a *wastewater treatment plant technician*. It is his job to see that the water that has been used by a community is clean for the next community that will use it.

An *oceanographer* has an interesting job. He studies the plant and animal life in an ocean, the ocean currents, tides, and temperatures. He may help commercial fishermen catch more fish; he may help people planning to build protecting breakwater walls or ship channels; he may help locate underwater mineral deposits.

ACTIVITY 2: Taking A Field Trip

Take the class to a water treatment plant or wastewater treatment plant. Have the attendant describe his duties as he guides the students through the plant.

ACTIVITY 3: Developing a Bulletin Board

Have the children develop a bulletin board with pictures of workers maintaining, developing, and protecting the natural resource of water. Have the children react to the display in class discussions.

EVALUATION:

Identify at least four occupations in the natural resource area of water.

State how different water workers contribute to your well-being and the welfare of the community and nation.

Section C - Air

Topic I

WHAT IS ATMOSPHERE?

GOALS: After this lesson the children should:

Understand the general composition of the atmosphere.

Understand the dimensions and divisions of the atmosphere.

ACTIVITY 1: Becoming Familiar with the Atmosphere

Composition of the atmosphere by percentages.

Nitrogen: Nitrogen gas makes up about 4/5 of the earth's atmosphere. This gas is very important to all living things because it is the essential element in proteins (see Step V, Grade 3-4, The Need for Food).

Oxygen: Without oxygen, plants and animals could not breathe, nor could fuels burn. Oxygen makes up about 1/5 of the earth's atmosphere.

Carbon Dioxide: The photosynthetic process tells us of the importance of carbon dioxide, CO_2 to the food-making capability of plants. No CO_2–no food–no living things. CO_2 makes up a very small percentage of the earth's atmosphere, about 3/1000 of 1 percent.

Water Vapor: The amount of water vapor present in the air varies depending on conditions. (See Section C–Water, Topic III.) The amount of water vapor ranges from 0-4 percent.

Dust Particles: There is a very small amount of dust in the atmosphere. This dust plays an important role in the formation of water droplets. (See Section C–"Water," Topic III.)

Other Gases: Helium, krypton, hydrogen, xenon, argon, and neon are also part of the atmosphere and are very important to man.

TEACHER'S NOTE: The important thing to emphasize when teaching children about the components of the atmosphere is that it is made up of particular things that have a particular purpose. This will be the basis for having the children understand the effect of air pollution.

ACTIVITY 2: Becoming Familiar With Atmospheric Layers

The atmosphere is an ocean of air that surrounds the earth and acts as a reservoir for the gases that are so vital to life on earth. The atmosphere has four divisions: troposphere, stratosphere, ionosphere, and exosphere.

Troposphere: We live in a troposphere, a layer of air that extends from 5-10 miles above the earth. We can live in it because the conditions for human life–temperature, pressure, and amounts of necessary gases–are present only in the lower part of this layer. As we go up in altitude and reach a level of 3-1/2 miles, there is, for example, only 1/2 as much oxygen as there is at sea level and the temperature is about –55°F. All weather occurs in the troposphere.

Stratosphere: The stratosphere extends from 10-50 miles up and is clear and cloudless except for occasional ice crystal clouds at about 15 miles.

A very important part of the atmosphere located 20-40 miles up is the ozone layer. This layer of very special oxygen atoms has the ability to absorb ultra-violet radiation from the sun. If all of these rays reached the earth, they would be deadly to living things.

Ionosphere: Between 50 and 400 miles above the earth there is an interesting layer called the ionosphere. An *ion* is an electrically charged particle and the ionosphere is filled with them. The air in the ionosphere is very, very thin, but still thick enough to cause meteors and meteorites to burn up; thus they do not damage the earth. The ionosphere also allows man to send radio messages around the world by "bouncing" electrical signals off the electrically charged particles (ions) and back down to the earth.

Exosphere: Air in the exosphere, which extends from 400 miles above the earth to 10-18,000 miles or until it can no longer be distinguished from outer space, is so thin that air molecules must travel enormous distances even to touch one another.

TEACHER'S NOTE: When teaching children about the divisions of the atmosphere, the emphasis should be on the relevance of each layer to life on earth. The fact that the layers exist, and that each plays an important role in making life possible on earth, is more significant than distances or amounts.

EVALUATION:

When children are asked to list the things that make up the atmosphere, they will include in their list: water vapor, dust particles, oxygen, nitrogen, carbon dioxide, and other gases.

When children are asked to tell what each of the above gases contributes to life on the planet earth (not to include other gases), they will demonstrate a knowledge satisfactory to the teacher of those uses mentioned in Activity 1.

When asked to describe the atmosphere in terms of layers going from the earth toward outer space, children will be able to put the layers mentioned in Activity 2 in the proper vertical sequence and demonstrate a knowledge of the characteristics of each layer that is satisfactory to the teacher.

Section C - Air Topic II

THE ATMOSPHERE AND RESPIRATION

GOALS: After this lesson the children should:

Understand the body's need for oxygen.

Understand the process of respiration in relation to the atmosphere.

ACTIVITY 1: Learning about Respiration

The body burns fuel (food) and the burning of fuel requires oxygen and gives off carbon dioxide. This occurs in the cells of animals. Blood from the lungs is rich in oxygen and low in carbon dioxide. Blood from the cells where fuel is being burned is low in oxygen and high in carbon dioxide.

Make an overhead transparency from Master C-14 and trace a molecule of oxygen and a molecule of carbon dioxide outside in and inside out.

1. The muscle is doing work and the cells in the muscle are using oxygen to burn fuel. This lowers the amount of oxygen in the cell below the amount in the blood stream and oxygen moves into the cell to be used.
2. While oxygen is being used to burn fuel, carbon dioxide is given off in the cell. This causes the amount of carbon dioxide in the cell to be greater than that in the blood and the carbon dioxide moves out of the cell and into the blood stream to be carried back to the lungs.
3. Blood arrives at the lungs in a condition of low oxygen and high carbon dioxide. The air in the lungs is high in oxygen and low in carbon dioxide. The carbon dioxide goes out of the blood into the air and the oxygen goes out of the air into the blood.
4. Blood with high oxygen is pumped around the body by the heart and the process continues.

TEACHER'S NOTE: Point out to the children that the real reason for breathing and circulation is to deliver oxygen to and remove carbon dioxide from the body's tissues. Children must understand the body's need for air with a particular quantity of pure oxygen in it or they will not understand the effect of air pollution on the human body.

EVALUATION:

Given the opportunity to explain the body's need for oxygen, the child will be able to demonstrate an understanding of the following:

Cells and tissues need oxygen to use food. When food is used, carbon dioxide is given off. Oxygen and carbon dioxide are transferred into and out of the body because they move from areas of high concentration to areas of low concentration.

Section C - Air Topic III

AIR POLLUTION

GOALS: After this lesson the children should:

Understand the sources and effects of air pollution on respiration.

ACTIVITY 1: Discussing Air Pollution and Health

While the gas carbon dioxide is so necessary to life, the removal of one atom of oxygen produces carbon monoxide, which is a danger to life.

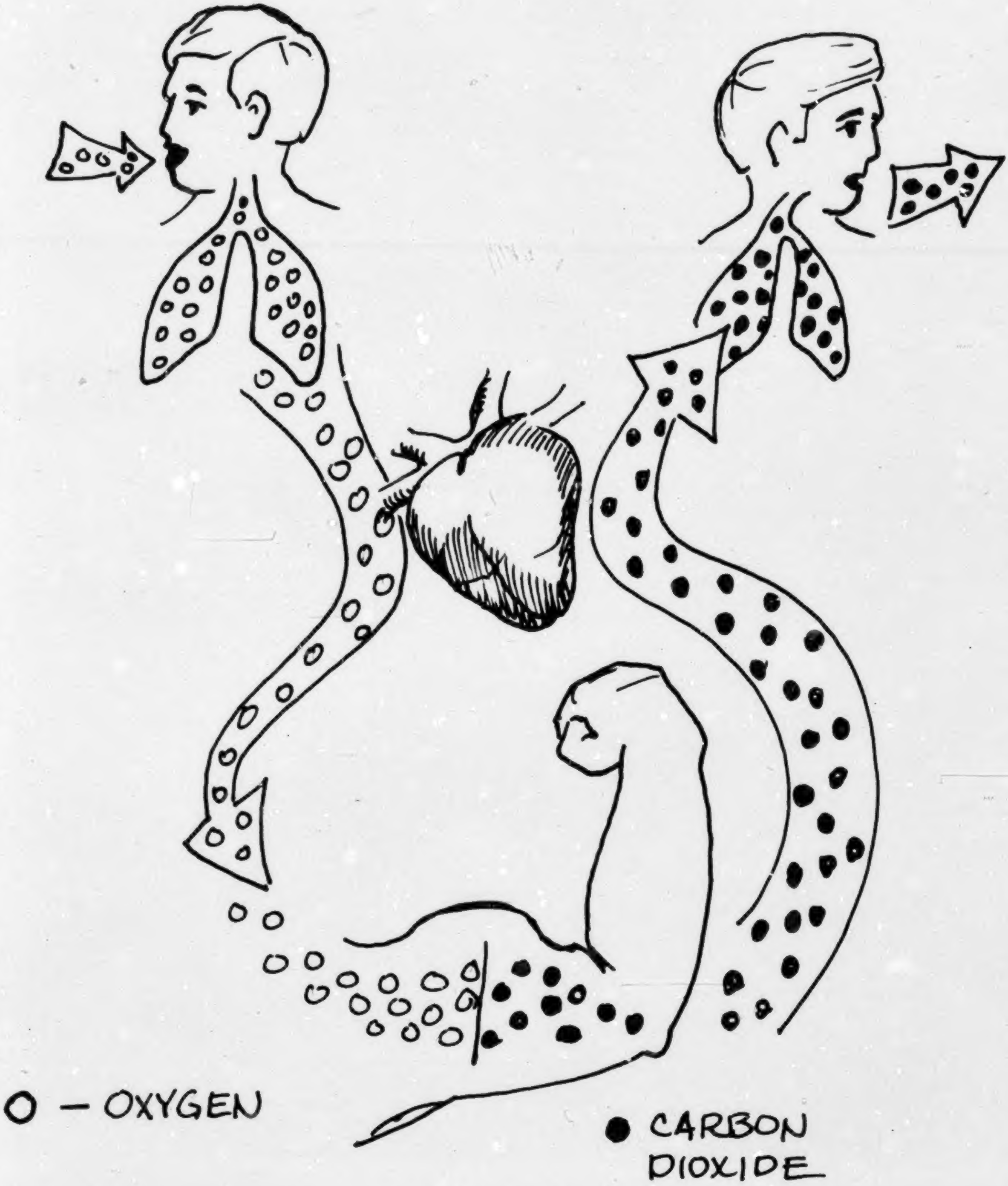
Carbon monoxide is a colorless, odorless, tasteless gas that we can take into our lungs without even knowing it.

Ask the children what would happen to them if they breathed ai containing high amounts of carbon monoxide.

TEACHER'S NOTE: If the children understand that the tissue need oxygen, then their initial conclusion should be that anythin besides oxygen may be harmful. The following information ma help to explain exactly why just one pollutant, carbon monoxide, i harmful to them.

We have discussed the body's need for oxygen and the way th body takes care of that need. If the air we breathe has hig amounts of carbon monoxide in it, then the blood cannot carr enough oxygen to the tissues where food is being burned, and th tissues will be harmed.

MASTER C-14


○ – OXYGEN
● CARBON DIOXIDE

ACTIVITY 2: Solving Air Pollution Problems

It is necessary to give children some idea of where air pollution comes from or they will not realize the effects of trying to stop it.

About 50 percent of all air pollution comes from transportation: cars, trucks, and so forth.

21 percent of air pollution comes from energy production (electricity).

14 percent from industrial processes.

8 percent from forest fires.

5 percent from solid waste disposal.

It is easy to see that any effort we make to reduce air pollution is going to affect four areas that are very important to us: transportation, electric power, industrial products, and solid waste disposal.

Using the figures above, have the class discuss the effect on themselves of solving air pollution problems.

The following question may help to start the discussion:

> What would happen if the manufacturer of your favorite candy bar were forced to put a one million dollar anti-pollution device on his factory's smokestack? How would it affect you? How would it affect you if he did not have to put the anti-pollution device on his smokestack, but just kept on producing pollution?

EVALUATION:

When asked to explain the effects of carbon monoxide pollution on the body, children will demonstrate an awareness of the fact that carbon monoxide in the air gets into the blood and causes the blood to be unable to carry as much oxygen as it should.

When asked to discuss the solution of air pollution problems, children will demonstrate by their comments that they are aware of the fact that pollution solutions are going to take money and citizens will have to pay at least a portion of that money.

Given the opportunity to set in order the sources of air pollution from highest to lowest, children will list as stated in Activity 2.

Section C - Air

Topic IV

ATMOSPHERIC CYCLES AND WEATHER

GOALS: After this lesson the children should:

Understand that weather is a condition of the atmosphere.

Understand and use knowledge about atmospheric conditions that will help them to forecast weather.

TEACHER'S NOTE: Relative humidity has been discussed under "The Water Cycle," Topic III, Section C–"Water," and will be used with this topic on weather.

ACTIVITY 1: Watching the Weather Report

Assign the children the task of watching a weather forecast on television for one week with the following objectives in mind:

> To become familiar with the terms used, especially *relative humidity, windspeed, wind direction, barometric pressure, cloud cover* and *type, precipitation,* and *cold* and *warm fronts.*

At the end of the week, ask the children the following question:

> What records would you need to keep in order to do your own weather prediction?

The class should now be familiar enough with weather terms to be able to know the components of a weather station.

ACTIVITY 2: Constructing a Weather Station

When the children are familiar with the kinds of information necessary to predict the weather, give them the opportunity to develop their own weather station, and to discover more about each facet of the atmosphere.

The development of weather instruments such as the wet-dry bulb hygrometer, the sling psychrometer, the barometer, the anemometer, the rain gauge, and the wind direction indicator will help the children to understand better each of the things that the instruments measure.

Should commercial instruments be available, the children should still be encouraged to make their own or at least be able to explain how the commercial instruments work. Commercial instruments are very helpful in testing homemade ones for accuracy.

Placement of the Weather Station: A weather station should be placed in an open area. It should be well ventilated but covered to protect the instruments from rain. Barometers can be placed in the classroom. The air pressure will be the same inside as it is outside. Worksheet C-5 provides plans for a weather station.

Contents of the Weather Station: A weather station should include a wet and dry bulb thermometer or a sling psychrometer, a rain gauge, a barometer, and a chart showing cloud types. Worksheet C-5 gives plans and parts for the construction of a weather station house and stand that can be made from decorative shutters.

Barometer: An Exercise on page 92 shows how to make a homemade barometer. If the children make one of these, have them explain to the class how and why it works. Ask them to think about other ways to measure barometric pressure.

TEACHER'S NOTE: *Barometric pressure* is really the pressure caused by the weight of the air above the barometer. It weighs about 15 pounds. If one were to weigh a 1 square inch column of air taken from sea level to the edge of the exosphere it would weigh approximately 15 pounds. The weight of the air will vary from day to day in the same place. This happens for two reasons: Warm air is lighter than cold air. Moist air is lighter than dry air.

You can see that an instrument that measures the temperature and moisture of the air above us would be very important in the prediction of weather. A change in the weight of the air can mean a change in moisture content or temperature or both.

Thermometer: The temperature at the weather station should be recorded at two times during the day, the highest point and the lowest point. This may be difficult to do because the lowest temperature usually occurs at night and the children are not in school. The local television or radio station gives highs and lows for the day. This can be used to supplement the record.

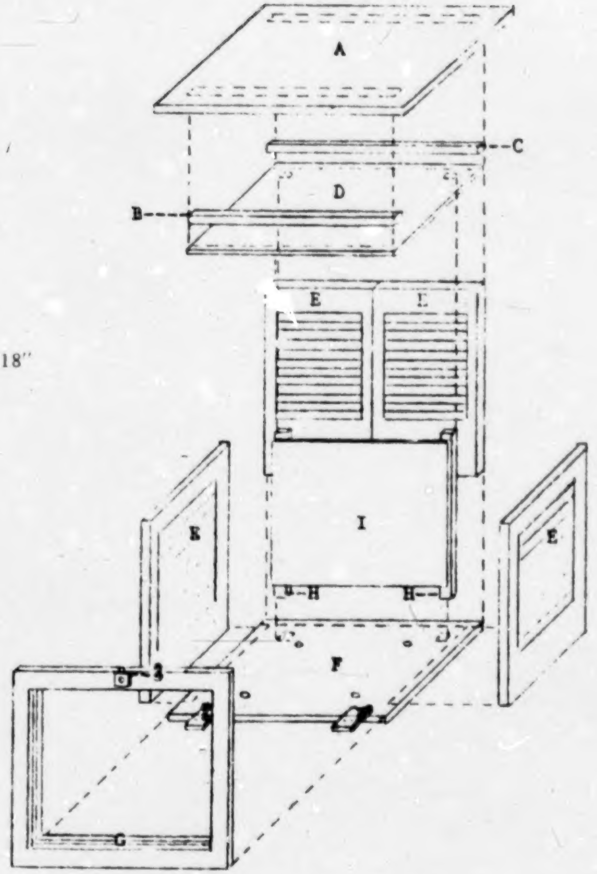
Rain Gauge: An Exercise on page 92 shows how to make a rain gauge. The dimensions are fairly important. Can the children figure out why this is so?

Precipitation should be measured over 24-hour periods of time and recorded.

Wet-Dry Bulb Thermometer or Sling Psychrometer: See page 82.

WORKSHEET C-5

CODE		DESCRIPTION
A	1	Plywood 1/2" x 17" x 28" AA Exterior Fir
B	1	White Pine 3/4" x 1-1/2" x 24"
C	1	White Pine 3/4" x 1" x 24"
D	1	Plywood 1/2" x 13" x 24" AA Exterior Fir
E	4	White Pine Shutters 1" x 12" x 18"
F	1	Plywood 3/4" x 14-3/8" x 24" AA Exterior Fir
G	1	Window Sash and Pane 1-1/4" x 20" x 24"
H	2	White Pine 3/4" x 1" x 18"
I	1	Masonite-Pegboard 1/8" x 16" x 18"
J	4	White Pine 1-1/2" x 2" x 42"
K	1	White Pine 1-1/2" x 2" x 18"
L	1	White Pine 1-1/2" x 2" x 19"
M	1	White Pine 1-1/2" x 2" x 27"
N	1	White Pine 1-1/2" x 2" x 29"



Weather Station

EXERCISE
MAKING A BAROMETER

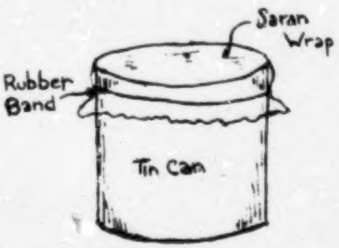
Make a tin can barometer.

Materials:

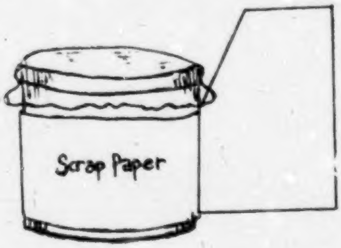
One tin can, a broom straw or soda straw, a rubber band, a piece of Saran Wrap (large enough to cover the top of the can), a piece of scrap paper, and a paper clip.

Construction:

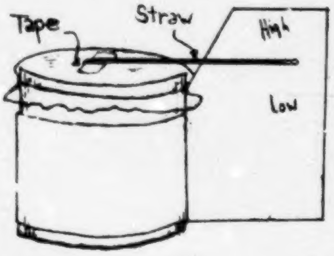
Place Saran Wrap over the top of the tin can and hold tight with the rubber band.



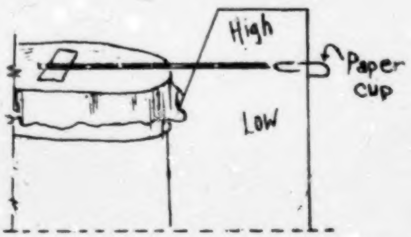
Wrap the paper around the can so part of it is higher than the top of the can, and staple in place.



Attach straw to the middle of the Saran Wrap with glue or tape.



Mark the position of the straw on the paper with a paper clip, and watch to see if the straw moves up or down.



If the straw moves toward the high, the weather will be fair.

If the straw moves toward the low, there is a storm coming.

EXERCISE
MAKING A RAIN GAUGE

Materials Needed:

1 1" olive jar (pickle jars will do if they are long and narrow)

1 5" funnel

1 coffee can (2#)

1 small file

If funnels or bottles of the sizes mentioned above are not available, the following formula may be used to determine the amount of rainfall:

$$\frac{r^2}{R^2} \times D = \text{Rainfall in inches}$$

r = Radius of olive jar

R = Radius of funnel

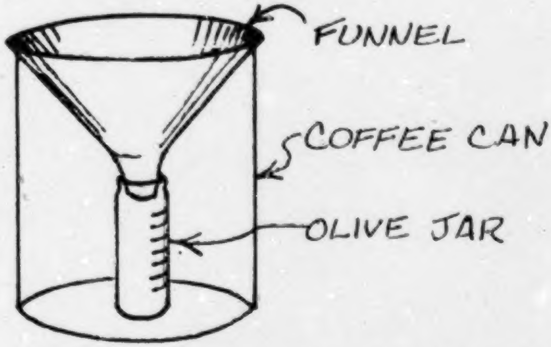
D = Depth of water in small container

Procedure:

a. Mark the pickle or olive jar in 1/4" increments using a small file to mark glass.

b. Place the funnel so that the rain goes directly into the small pickle or olive jar.

c. The coffee can should be completely covered by the funnel so that water will not get into the can unless it overflows from the pickle or olive jar.



Wind Speed: Worksheet C-6 contains a Beaufort Scale of wind force which can be used to estimate the speed of the wind.

ACTIVITY 3: Predicting the Weather

Using the chart on Worksheet C-15 have the children keep accurate records of the instrument readings and observations. The first month should be devoted to the correct gathering of information and description of the actual weather that exists each day.

After one month of collecting data and recording actual weather conditions, let the children see if they can predict weather for the days ahead by using the data collected before.

This is a matter of looking at a particular set of conditions and saying, *the last time these conditions were present such and such a thing happened.* Let them discover the relationship between accurate data collection and prediction from past records.

EVALUATION:

Given the opportunity to explain weather instrument construction and use, children will demonstrate an understanding of the particular principles that make the instruments work.

Given the opportunity to predict the weather, children will be able to demonstrate an ability to recognize cause and effect relationships between recorded weather data and actual weather conditions.

WORKSHEET C-6

Beaufort Scale of Wind Force

Beaufort Number	Specifications for Use on Land	Miles per Hour (statute)	Terms Used in U. S. Weather Bureau Forecasts
0 ____	Calm; smoke rises vertically ____	Less than 1	
1 ____	Direction of wind shown by smoke draft, but not by wind vanes ____	1-3	
2 ____	Wind felt on face; leaves rustle; ordinary vane moved by wind ____	4-7	Light
3 ____	Leaves and small twigs in constant motion; wind extends light flag ____	8-12	Gentle
4 ____	Raises dust and loose paper, small branches are moved ____	13-18	Moderate
5 ____	Small trees in leaf begin to sway; crested wavelets form on inland waters ____	19-24	Fresh
6 ____	Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty ____	25-31	
7 ____	Whole trees in motion; inconvenience felt in walking against wind ____	32-38	Strong
8 ____	Breaks twigs off trees; generally impedes progress ____	39-46	
9 ____	Slight structural damage occurs (chimney pots and slate removed) ____	47-54	Gale
10 ____	Seldom experienced inland, trees uprooted, considerable structural damage occurs ____	55-63	
11 ____	Very rarely experienced; accompanied by wide-spread damage ____	64-75	Whole gale
12 ____	____	Above 75	Hurricane

WORKSHEET C-7

DATE	TEMP.		REL. HUM	PRECIP.	WIND.		CLOUD-COV.	CLOUD-TYP.	PREDICTION
	HIGH	LOW			SPEED	DIR.			

Section C - Air

Topic V

PEOPLE WHO PROTECT OUR ATMOSPHERE

GOALS: After this lesson the children should:

Be aware of the occupations that are available in the natural resource area of air.

Understand the nature of the work tasks performed by air pollution control workers.

ACTIVITY 1: Discussing Air Pollution Control Occupations

The air surrounding the earth is so vast that it is difficult to think that we can actually put enough harmful materials into it to cause injury to plants, animals, and to ourselves. Yet this is exactly what has happened to the air around many cities. The problem is especially bad on hot days when there is very little air movement. The exhaust gases from automobiles contribute a major portion of these air pollutants, while industrial plants contribute much of the rest.

The cities, states, and the federal government employ *air pollution control supervisors* who conduct studies of air pollution, recommend control measures, and report air polluters who refuse to comply with laws designed to reduce pollution. They are assisted by *air pollution control technicians* who collect and analyze air samples for detection of air polluting chemicals, test anti-pollution devices, investigate cases of pollution, and estimate costs of equipment to control air pollution. Air pollution control technicians usually specialize in a particular kind of work, and may be called *air monitoring technicians, source testing technicians, compliance section technicians,* or *engineering section technicians.* A person who helps these technicians by keeping equipment in working condition, operating equipment, and recording readings is an *air pollution control aide.*

ACTIVITY 2: Taking a Field Trip

Arrange to take the class to an air monitoring station. Have the air monitoring personnel discuss their work with the class.

ACTIVITY 3: Preparing a Bulletin Board

Have each child cut out an illustration from a magazine or newspaper which illustrates air pollution control workers. Group these pictures on a bulletin board so as to illustrate the many different jobs in the protection of the air.

Have students study and react to the display in class discussions.

ACTIVITY 4: Interviewing Workers

If possible, have one or more students interview a parent, relative, or close friend who is employed in an occupation dealing with minearals and/or petroleum products. Have class members discuss kinds of information and questions to ask. Following the interview, have the students identify the career explored, present findings, and answer any questions the classmates may ask.

EVALUATION:

In an oral exercise, the student can identify at least two types of workers who contribute to the protection of the atmosphere. The student can state how different air pollution control workers contribute to his well being and the welfare of the community

Section C - Land Space

Topic I

LAND USE PLANNING

GOALS: After this lesson the children should:

Understand man's use of land space in terms of agriculture, buildings, transportation, and recreation.

Appreciate the amount of land used for each of the above purposes.

Be able to measure land.

ACTIVITY 1: Pacing

Land is usually measured in acres or parts of an acre. An *acre* of land consists of 43,560 square feet. This figure is relatively meaningless to a child because it is difficult for a child or an adult to conceive 43,560 of anything. It is much more effective to have the child experience an acre. This activity is a good math experience and will help the child to appreciate better an acre of land space.

Each child will have a pace or step that is unique to him.

Measure off 100 feet on the school grounds and have each child walk the 100 feet and count the steps it takes him to walk [illegible] and back, one round trip.

Have the children divide the number of steps by two and get the average number of steps per 100 feet.

Ask the children to figure out how far they walk when they take one normal step. For example, if a child takes 50 steps per 100 feet, then the length of his step is two feet.

A *pace* is defined as two steps. Therefore, the child in the example above would have a pace of four feet.

ACTIVITY 2: Measuring Land

The children are now ready to measure land space and to compare the amount of space used for different things.

If your school ground is four sided, have the children pace off the perimeter and figure out how many acres are in the total school property. If the school does not lend itself to this kind of measurement, then make measurements of particular things such as:

Area used for the school building.

Area used for parking cars.

Area used for sidewalks.

Area used for play.

Area used for other things.

If you have enough open space around the school, let the children measure off one acre. This is a square with about 208 feet on a side. Let them walk around it, stand inside of it and look out, and generally get the feeling for its size.

ACTIVITY 3: Discussing Land Use

TEACHER'S NOTE: There are 2 billion, 266 million acres of land in this country. Our problem is to help the children to see how it is used. The following activity will help them to do this:

We have identified one acre in Activity 2. The following information can be used to show the children how much of each acre in our country is used for cropland (20%), grazing land (28%), forest land (33%), recreational land (3%), special use of land–highways, roads, towns, airports, wildlife refuges, and any land requiring development–(4%), and miscellaneous uses–deserts, marshes, bare rock areas, tundra–(12%).

Have the children divide a square acre into segments proportional to land uses in this country.

Cropland: Measure 41.6 feet along one side and draw a perpendicular line to the other side.

Grazing Land and Pasture Land: Measure 56.6 feet and draw a perpendicular line to the other side.

Forest Land: Measure 68.6 feet and draw a perpendicular line to the other side.

Recreation Land: Measure 6.2 feet along one side and draw a perpendicular line to the other side.

Special Purpose Land: Measure 8.3 feet along one side and draw a perpendicular line to the other side.

Miscellaneous Land: Measure 25 feet along one side and draw a perpendicular line to the other side.

TEACHER'S NOTE: Every year as our population grows, the way land is used changes. For example, about 2 million acres of land each year are converted from agricultural to non-agricultural use. One million acres are converted to recreation areas, 160,000 are covered by highways, 420,000 become reservoirs and flood control projects, and 420,000 are developed for urban uses.

A square out of the acre that shows the amount of land people actually live on in this country would be very small in comparison to the others, and would measure about 20 feet on a side. We use more land for highways and roads than we live on.

Point out the relationship of population growth to land use patterns.

Ask the children this question: If our population keeps increasing and our cities keep getting larger and larger, what will happen to the rest of the land?

One mile of interstate highway takes about 10 acres of land. What will happen if we continue to build highways? What will happen if we do not?

EVALUATION:

Given the opportunity to measure an area of open space by pacing, the child will be able to measure it and determine how many acres or what part of an acre the land is.

Given the opportunity to list the ways that land is used in this country, the child will mention forest land, grazing land, cropland, recreation land, land to live and travel on, and land that is not used because it is desert, tundra, or marsh.

Section C - Land Space

Topic II

OCCUPATIONS IN LAND USE PLANNING AND OUTDOOR RECREATION

GOALS: After this lesson the children should:

Be aware of occupations in the areas of land use planning, zoning, and outdoor recreation.

Understand the nature of the work tasks performed by workers in these areas.

ACTIVITY 1: Discussing Occupations in Land Use Planning

Our country has many kinds of land–mountains, plains, hills, swamps, deserts. Some soil is rocky and steep; some is deep and fertile. Our most important land is the land that is suitable for growing crops that feed us. It must have adequate rainfall (or irrigation water) and be reasonably level and free of rocks so machinery can be used on it. It must drain well and be reasonably fertile. Our next most important land is where factories, houses, schools, and public buildings are built. These make up towns and cities. They require fairly level land that drains well; the soil need not be fertile, and rocks are not a serious problem. Land that is too steep, rocky, and infertile for cities or farms is often reserved as forests which supply us with wood for buildings, furniture, and paper. Rangelands are areas of limited rainfall suitable for cattle and sheep if they are given plenty of space to search for food.

When our country was young, there were far fewer people and there seemed to be plenty of land for all purposes. Now cities and towns are growing, farms must produce more food than before, and even our forests must be carefully managed so we can have a steady supply of wood products. Frequently people in a community now have to ask themselves if a particular area of land would be best used for producing crops or for new factories and houses. Often so many facts have to be collected and studied before a decision can be made that a community, township, county, or state may have experts in land planning to help them.

Land planning usually involves a study of the land area as it is now used and making plans that involve its future use. Rarely is it possible to plan a new city where none existed before; and a whole new area of cropland is developed only on the unusual occasion of a large new dam being built to supply irrigation water.

A *chief planner* is a person who has very carefully studied alternative ways to use land. He has traveled a lot to study how people have used land and how they have decided upon the best use. His main work is to advise land planners and municipalities as they work together to solve land use problems. He is an expert consultant.

A *land planner* (also often called city planner, urban planner, regional planner, or town planner) is usually employed full time by a city, township, or county to recommend how its land can best be used. He studies maps of the physical features of the area and suggests ways of improving what is already there. He makes maps of proposed use, showing where homes, stores, schools, apartments, and factories might best be placed. He also shows where roads and water and sewage lines should go and where parks should be located so most people can get to them easily.

A *planning technician* (also often called a planning associate or planning analyst) is responsible to the land planner. He collects the information about an area, such as soil type, land features, existing structures, road systems, sewage systems, water systems, and electrical power. He also determines how rapidly people, businesses, and industry or agriculture are likely to move into the area. From all of this information he draws plans (perhaps several alternative ones) showing how the land space could best be used to satisfy the interests of everyone concerned.

A *planning aide* works under the supervision of a planning technician. He collects the information needed by examining maps and in some cases by surveying an area. He does the actual drawing of alternative plans under the direction of the planning technician.

A *zoning inspector* works for a city or town or township. He inspects houses, factories, and other buildings or structures under construction to see that they comply with zoning laws and safety codes. Most cities, towns, and townships have mapped certain places for houses, others for apartments, businesses, and factories. Each of these areas is a "zone." The inspector makes sure that someone does not build a factory (for example) in a place where only houses are supposed to be built. A *zoning technician* helps the zoning inspector by drawing maps, answering questions about zoning, and sometimes by also making inspections.

ACTIVITY 2: Discussing Occupations in Outdoor Recreation

Many cities have open spaces with trees and lawns and play areas because most people are happier when they can be outdoors playing games, walking, or resting in pleasant places during their leisure time.

Many states have large parks on rivers, lakes, oceans, or in forested land where people can go hiking, swimming, or fishing. There are similar privately owned areas that are camps and parks where the same things can be done.

The federal government also has developed national forests, parks, and "monuments" where people can enjoy their vacations doing interesting things outdoors. Many of these national areas are especially preserved because of their historical importance, such as Valley Forge or Gettysburg. Others are preserved for their natural wonders, such as the Grand Canyon or Glacier National Park.

The parks are kept neat and clean by *park workers* who mow the lawns, care for the trees and shrubs, repair buildings and structures, and dispose of rubbish.

In a campground, the person who maintains the park is called a *campground caretaker*. He makes sure the campground is neat and clean at all times and that campers obey the rules that are set up so everyone will enjoy camping. People working under his direction collect camping fees, mow lawns, collect rubbish, and do many other things. If there is swimming, he supervises the life guards.

If the park is a large one with interesting plants, animals, trees, streams, or rock formations, it may have a *park naturalist*. He often conducts tours, gives talks, or sets up exhibits to explain to visitors the special things in the park.

Some parks are so large that people can easily get lost in them while hunting or fishing. *Hunting and fishing guides* may be hired to help visitors find their way in parks. These guides also know where certain fish or animals are most likely to be found.

A park of any size usually has a *park foreman* who supervises the workers in the park and keep things running smoothly so visitors enjoy being in the park.

ACTIVITY 3: Taking a Field Trip

Arrange to take the class to a regional planning office and/or a municipal, state, or federal park. Have the workers describe their work duties to the children.

ACTIVITY 4: Preparing a Bulletin Board

Have each child cut out an illustration from a magazine or newspaper which illustrates land use planning and outdoor recreation workers. Group these pictures on a bulletin board so as to illustrate the many different jobs in these areas. Have students study and react to the display in class discussions.

EVALUATION:

In an oral exercise, the student can identify at least three occupations in land use planning and three occupations in outdoor recreation.

The child can state how these different occupations contribute to his well being and the welfare of the community.

Section C - Minerals Topic I

MINERALS AND MINERAL FORMATION

GOALS: After this lesson the children should:

Understand the structure and formation of minerals.

ACTIVITY 1: Discussing Minerals

Minerals are elements or combination of elements.

Discuss the following statements with the children:

Gold is an element and a mineral. It is not combined with anything else and can be found in nature in the pure state.

Quartz on the other hand, is a combination of two elements, silicone and oxygen. These two elements combine to form SiO_2 or quartz.

Minerals that are elements were formed when the earth was born.

Elements then began to combine under certain conditions of temperature and pressure and form other minerals.

ACTIVITY 2: Growing Crystals

One of the physical characteristics that is unique to minerals is crystal formation.

Have the children look at grains of sand, salt, and sugar under a microscope and draw the predominate shape they see. These shapes are unique to each of the minerals and can be used to identify them.

The following demonstration will give the children the opportunity to observe crystal formation.

Materials Needed:

- 1/4 cup salt
- 1/4 cup bluing
- 1/4 cup water
- 1 tablespoon ammonia

Procedure:

Mix the above together and pour over crumbled paper towels in a pie pan. Add small amounts of food coloring and the colors will show up in the crystals. Crystals will start to form in about one hour and will continue for about five hours.

Have the children observe and describe some of the crystals.

TEACHER'S NOTE: The observation of crystal growth above is a "fast" version of what happens in nature. Certain materials have an affinity for combining with each other and forming crystals. This usually takes a very long time and depends on the proper temperature and pressure.

EVALUATION:

Given the opportunity to discuss minerals, the children will demonstrate by their comments a knowledge of the following:

Minerals are elements or combinations of elements. Minerals have definite chemical and crystalline structures.

Section C - Minerals

Topic II

ROCK AND MINERAL IDENTIFICATION AND CLASSIFICATION

GOALS: After this lesson the children should:

Understand that pressure and temperature are both factors in the formation of rocks and minerals, and that rocks and minerals can change after their initial formation.

Be familiar with basic techniques for determining physical and chemical characteristics of rocks and minerals.

ACTIVITY 1: Classifying Rocks.

Rocks are simply combinations of minerals. Some rocks are made up of one major mineral, limestone is a good example of this. It is very important to have children discover that there are many different kinds of rocks that have many different uses.

Rocks are classified according to the manner in which they were formed.

Sedimentary Rock:

The seas crept onto the land and then receded over and over again when the earth was very young. Each time this happened, a layer of mud and sand settled out and remained behind.

As one layer after another built up the lower layers began to be compressed and form rock.

One of the characteristics of the sedimentary rock is this layering. If there are rock outcroppings near the school that show definite layers, it is probably sedimentary rock.

Igneous Rock:

Molten material from within the earth that cooled and hardened formed igneous rocks. Igneous rocks usually occur well below the surface of the earth.

Metamorphic Rock:

The word metamorphic means change. Metamorphic rocks are those that have been changed by heat and pressure from igneous or sedimentary rocks. These rocks were usually formed during the mountain forming period when the bending of the earth's crust caused the tremendous heat and pressure necessary to change rocks. Metamorphic rocks are usually layered or banded.

ACTIVITY 2: Identifying Rocks

The first step in the identification of rocks is to get them into the proper formation category. Use Worksheet C-8 as a guide.

Layering:

If a rock is banded or layered, it is not igneous.

If the rock is layered and the layers are very thick, one to two feet, it is probably a sedimentary rock.

The layering in metamorphic rocks is usually thin and each layer represents a particular mineral. Often light and dark colored minerals alternate with each other.

After a rock has been put into a general classification, further investigation is necessary in order to give the rock a particular identification.

Hardness:

All rocks and minerals have a particular degree of hardness as measured on the hardness scale of 1-10. Number 1 is talc and Number 10 is diamond. Commercial hardness scales are available but not necessary for the elementary exploration of rocks. The following guide can be used:

Hardness	*Item*
2	Fingernail
3	Copper penny
5	Nail
5-1/2	Window glass
6-1/2	Steel file

Color of Streak:

Very often the exterior color of a rock is misleading. It may have oxides on it that hide the true color of the minerals that make it up. The streak is uncovered by rubbing a piece of rock on a white unglazed tile. (The back of any piece of bathroom tile will serve this purpose very well.)

Texture:

Have the children feel the rock. Is it rough or smooth?

Luster:

There are two divisions of luster that are easily observable. Metallic (shiny) or nonmetallic (dull).

Crystal Shape:

Some rocks will have crystals that are large enough to recognize without a magnifying lens, while some will require very heavy magnification to see the crystals.

Effervescence:

Some rocks will react to acid dropped on them by giving off bubbles. This is especially true of the carbonate minerals. Vinegar can be used as the acid.

ACTIVITY 3: Building a Rock Collection

The most important concept for children to develop at this level is that rocks are different and can be put into various study groups according to the criteria mentioned above.

WORKSHEET C-8

No.	Color Outside	Color Streak	Texture	Hardness	Luster	Crystal	Vinegar Test	Classification: Igneous, Metamorphic or Sedimentary

Have the children bring some rocks into the classroom to study, and to compare. A chart like the one shown in Worksheet C-17, will help the children to compare their rocks. A small dab of white paint can be put on each rock so that an identification number can be written on it.

Information should be placed on the chart according to the tests or indicated observations mentioned in Activity 2.

After this is done, have the children go to the library, and try to find information about the particular kinds of rocks that they have been studying.

EVALUATION:

Given the opportunity to discuss the formation of rocks and minerals, the children will demonstrate an awareness of the following:

Rocks and minerals are formed by one of three processes: heat (igneous), pressure (sedimentary), and change (metamorphic).

Given the opportunity to identify an unknown rock, the child will demonstrate an awareness of the fact that he must determine the following:

Hardness, luster, color, streak color, texture, effervescence, and crystal shape.

Section C - Minerals Topic III

MINERAL USE

GOALS: After this lesson the children should:

Appreciate the value of minerals in a technological society.

Understand the kinds of, and uses for, minerals.

ACTIVITY 1: Inventorying Minerals

Have the children make a list of all the things they see around them that are made from or require the use of minerals. This can take as long as necessary, but two or three days of casual observation should provide a good list.

Now divide the general list into use categories as suggested below:

Buildings:
Clothing:
Transportation:
Toys:
Jewelry:
Other:

ACTIVITY 2: Determining the Source of Minerals and Mineral Products

Have each child choose a mineral from the list and find out as much about it as he can. The following guidelines will help:

What is the material?

What minerals go into the making of the material?

Where do the minerals come from?

How much of the minerals are there on earth?

What kinds of processes are used to make the minerals usable?

What kinds of jobs are necessary to find the minerals?

Have the children share the information they found.

ACTIVITY 3: Using Minerals Well

Have the children find samples of unwise use of non-renewable resources and discuss possible solutions to the problems.

EVALUATION:

Given the opportunity to identify mineral uses, the child will, to the satisfaction of the teacher, demonstrate an awareness of the uses that are made of minerals and mineral fuels in his neighborhood.

Given the opportunity to study a particular non-renewable natural resource, the child will demonstrate, through sharing information with his classmates, a knowledge of the answers to the questions in Activity 3.

Section C - Minerals Topic IV

PEOPLE WHO WORK WITH MINERALS AND PETROLEUM FUELS

GOALS: After this lesson the children should:

Be aware of occupations that are available in the area of minerals and petroleum fuels.

Understand the nature of the work tasks performed by selected mineral and petroleum fuel workers.

ACTIVITY 1: Discussing Occupations in the Mineral and Petroleum Fields

Oil, gas, coal, limestone, and other minerals are natural resources that are extracted from the ground by means of wells, tunnels, or open pits. These materials are not replaceable, and must be used wisely. People are employed in finding these minerals, in taking them from the earth, and in making sure that the work is done safely with as little damage to the environment as possible. A *petroleum geologist* studies rock formations and maps of existing oil and gas wells to figure out places where oil and gas are likely to be found. By examining the material removed from test drilling, this individual can tell whether it is worthwhile to continue to test drill at a particular site. An *oil and gas inspector* inspects oil and gas wells and processing plants to determine whether all safety laws and laws to protect the environment are being followed. Leaking gas or oil or by-products can cause severe damage to plants and animals. Fires are a constant hazard. A *mining area restoration* technician runs tests on the air, land, and water in the vicinity of mines to determine whether the environment is being damaged by acid mine water, air pollutants, or seepage from mine dumps. This individual offers advice on how to stop the pollution if it is found. The *mining area restoration technician* also supervises the filling in and closing of old mines for public safety and supervises the fighting of mine fires. An *open pit mine conservation inspector* makes sure that all state and federal safety laws are obeyed in open pit-mining operations. When mining operations are having a harmful effect upon the environment, this individual takes the necessary steps to stop pollution. The open pit mine conservation inspector may supervise the regrading of the land and the planting of tree seedlings.

ACTIVITY 2: Role Playing

After discussing the occupations in minerals and petroleum fuels, have each student select an occupation of interest to him, investigate the occupation more thoroughly in reference books and encyclopedias, and role play a typical work role or job situation.

ACTIVITY 3: Interviewing a Resource Person

Invite a worker in the area of minerals and petroleum fuels to come and speak to the class about his occupation and typical work tasks performed.

EVALUATION:

The student can state how different mineral and petroleum fuels workers contribute to his well-being and the welfare of the community and nation.

The student can identify at least four types of workers who work with minerals and petroleum fuels.

Appendix A

SELECTED LIST OF REFERENCE BOOKS FOR EARLY ELEMENTARY SCHOOL CHILDREN

Allen, Gertrude. *Everyday Trees.* Boston: Houghton Mifflin, 1968.

Bendick, Jeanne. *A Place to Live.* New York: Parents' Magazine Press, 1970.

Bloomie, Enid. *The Air We Breathe.* New York: Doubleday and Co., Inc.,1971.

Carrick, Carol, and Donald Carrick. *The Pond.* New York: Macmillan, 1970.

Gates, Richard. *The True Book of Conservation.* Chicago: Children's Press, 1959.

Hogner, Dorothy Childs. *Birds of Prey.* New York: Cowell, 1969.

Hornblow, Leonora, and Arthur Hornblow. *Animals do the Strangest Things.* New York: Random House, 1964.

Howell, Ruth R. *Everything Changes.* New York: Atheneum, 1968.

Knight, David C. *Let's Find Out About Weather.* New York: Franklin Watts, Inc., 1967.

Laycock, G. *Animal Movers: A Collection of Ecological Surprises.* New York: Doubleday and Co., 1971.

Oppenheim, Joanne. *Have You Seen Trees?* New York: William R. Scott, Inc., 1967.

Peterson, Otis. *Junior Science Book of Water.* Champaign, IL: Garrard Publishing Co., 1966.

Selsam, Millicent. *You and the World Around You.* Garden City, New York: Doubleday and Co., Inc., 1963.

Tresselt, Alvin. *The Beaver Pond.* New York: Lothrop, Lee and Shepard Co., 1970.

Wentworth, Daniel F. *Pollution: Examining Your Environment.* Minneapolis; Mine Publications, Inc., 1972.

Appendix B

SELECTED LIST OF REFERENCE BOOKS FOR MIDDLE ELEMENTARY SCHOOL CHILDREN

Allen, Dorothy Holmes. *The Story of Soil.* New York: G. P. Putnam's Sons, 1971.

Arbital, Samuel L. *Cities and Metropolitan Areas in Today's World.* Mankato, MN: Creative Education Society, 1968.

Billington, Elizabeth T. *Understanding Ecology.* New York: Frederick Warne and Co., 1968.

Buehr, Walter. *Water: Our Vital Need.* New York: W. W. Norton and Co., 1967.

Busch, Phyllis S. *At Home in Its Habitat: Animal Neighborhoods.* Cleveland: The World Publishing Co., 1970.

————————. *City Lots: Living Things in Vacant Spots.* Cleveland: The World Publishing Co., 1970.

————————. *Once There Was a Tree: The Story of the Tree, Changing Home for Plants and Animals.* Cleveland: The World Publishing Co., 1969.

————————. *Puddles and Ponds: Living Things in Watery Places. Cleveland: The World Publishing Co., 1969.*

Cohen, Daniel. *Animals of the City.* New York: McGraw-Hill Book Co., 1969.

Freeman, Mae. *When Air Moves.* New York: McGraw-Hill Book Co., 1968.

Friendly, Natalie. *Miraculous web: The Balance of Life.* Englewood Cliffs, New Jersey: Prentice-Hall, 1968.

Gallant, Roy A., and Christopher J. Schuberth. *Discovering Rocks and Minerals: A Nature and Science Guide to Their Collection and Identification.* Garden City, New York: Natural History Press, 1967.

Gay, Kathyln. *Where the People Are: Cities and Their Future.* New York: Delacorte Press, 1969.

Grossman, Shelly, and Mary Grossman. *The How and Why Wonder Book of Ecology. New York: Grosset and Dunlap, 1971.*

Leinwand, Gerald, ed. *Air and Water Pollution,* New York: Washington Square Press, 1969.

Matthews, William H. III. *The Story of the Earth.* Irving-on-Hudson, New York: Harvey House, Inc., 1968.

Mattison, Charles W., and Joseph Alvarez. *Man and His Resources.* Mankato, MN: Creative Educational Society, 1967.

Raskin, Edith. *The Pyramid of Living Things.* New York: McGraw-Hill Book Co., 1967.

Russell, Helen R. *City Critters.* New York: Meredith Press, 1969.

————————. *The True Book of Buds; Surprise Packages.* Chicago: Children's Press, 1970.

Stone, A Harris and Irving Leskowitz. *Plants Are Like That.* Englewood Cliffs, NJ: Prentice-Hill, 1968.

Zarcone, John. *Our Cities, Our Pride and Our Problem.* New York: Makor Educational Industries, 1969.

Appendix C

SELECTED LIST OF REFERENCE BOOKS FOR ELEMENTARY SCHOOL TEACHERS

Boyer, Robert E. and Jon L. Higgins. *Activities and Demonstrations for Earth Science.* Englewood Cliffs, NJ: Prentice-Hall, 1970.

Carvojal, Joan and Martha E. Munzer. *Conservation Education: A Selected Bibliography Supplement.* Danville, IL: The Interstate Printers and Publishers, 1971.

Day, Albert M. *Making a Living in Conservation.* Harrisburg, PA: Stackpole Books, 1971.

Fanning, Odom. *Opportunities in Environmental Careers.* New York: Universal Publishing and Distributing Corp., 1971.

Jones, Orville C., and Malcolm D. Swan. *Discovering Your Environment.* Danville, IL: Interstate Printers and Publishers, 1971.

Koestner, E. J., J. McHugh, and R. Kircher. *The Do It Yourself Environmental Handbook.* Boston: Little Brown and Co., 1972.

Leavitt, Jerome and John Huntsberger. *Terrariums and Aquariums* Chicago: Childrens Press, 1964.

Milliken, Margaret, Austin F. Hamer, and Ernest C. McDonald. *Field Study Manual for Outdoor Living.* Minneapolis, MN: Burgess Publishing Co., 1968.

Pringle, Laurence P., ed. *Discovering the Outdoors: A Nature and Science Guide to Investigating Life in Fields, Forests, and Ponds.* New York: Natural History Press, 1969.

U.S. Department of Agriculture, Soil Conservation Service. *An Outline For Teaching Conservation in Elementary Schools, PA-268.* Washington, DC: U.S. Government Printing Office, 1971.

____________________. *Outdoor Classrooms on School Sites,* PA-975. Washington, DC: U.S. Government Printing Office, 1972.

____________________. *Teaching Soil and Water Conservation, A Classroom and Field Guide. Washington, DC: U.S.* Government Printing Office, 1970.